POWER

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A Perpetual Power Show

NEXT week the annual Power Show will open in New York—bigger, better and more interesting than ever, I am told.

How much it would mean for an engineer from some little backwoods town to step in and look it over!

He would see boilers as different from those that he runs as a Rolls-Royce is from a horse and buggy.

He would see steam turbines not much bigger than his feed pumps that would turn out power enough to run his whole mill.

He would see mechanical apparatus unloading, weighing, crushing, transporting and firing coal and disposing of ashes, in place of the human labor that he uses for these purposes.

He would see in operation systems by which the proportioning of fuel to load of air and water to fuel is performed automatically with greater precision than by human manipulation.

He would see new designs and construction of furnaces, uptakes, conduits, connections, new materials for various purposes, new tools and devices for the easier accomplishment of tasks over which he sweats, instruments for guidance in the direction and operation of a plant and for the measurement and recording of the results attained.

He would meet and exchange ideas with other engineers and listen to papers and lectures upon power subjects.

And he would go home to his backroad plant with bigger ideas of his occupation and opportunities, with a new interest and awakened zeal.

The opportunity to do this comes to comparatively few, but the thought with which I took my pen in hand was that in a paper like *Power* one has a perpetual Power Show.

There would be little if anything in a Power Show about which a regular and conscientious reader of *Power* would not know something. He has seen the apparatus described, illustrated and discussed in both the reading and advertising sections; he has read and perhaps taken part in the exchange of thought between thinking engineers upon current topics. He has read lectures in the quiet of his home instead of trying to listen to them in the din of an exposition hall.

It is better to see these things in iron and brass and steel than in pictures, better to enjoy the animation of actual participation than to read about it, but in the absence of the possibility of actual attendance at these occasional affairs one may realize much of the edification and benefit that they afford by an appreciative reading of his technical paper.

F. R. Low

Steel-Mill Power Plant Has Many Unusual Features

NEW station of the Bethlehem Steel Corp., at Johnstown, Pa., has 18,750-kva. turbine unit and eight 9,770-sq.ft. boilers, fired with a 50-50 mixture of coke screening and bituminous coal on underfeed stokers. A total of 186 boilers are installed at this works. About 80 per cent of all steam is produced from waste fuel.

POWER generation in a large steel mill has proportions comparable with a modern central-station system. A good example is the Cambria Works of the Bethlehem Steel Company, at Johnstown, Pa. Here 186 boilers, with a combined steam-making surface of over 630,000 sq.ft., supply steam to three power plants having an aggregate capacity of 45,000 kw. in turbine-generator units. Over 4,200 motors, with a total capacity of 169,000 hp., are supplied from these plants. The boilers also furnish steam to seventeen blowing engines for the blast furnaces, twenty rolling-mill engines and for other purposes about the works. The new Gautier plant is electrically driven, a large part of the equipment being direct-current motors, supplied from a substation having installed five 2,000-kw. motor-generator sets, driven by 6,600-volt synchronous motors.

A works like this, involving, as it does, 490 byproduct coke ovens, 10 blast furnaces and approximately 100 heating furnaces of various kinds, offers large opportunities for the utilization of waste fuel and heat. Approximately 80 per cent of the steam in these works is now produced from waste fuel and heat. It is expected that future developments will make it possible to produce practically all the steam without burning coal.

The waste fuel consists chiefly of blast-furnace gas, coke breeze, and coke screenings from the blast furnaces. Coke breeze can be readily burned on chain-grate stokers. Extensive investigations were carried on by the company's engineers to develop a method of burning coke screenings on underfeed stokers. The final outcome of this was burning the material in combination with bituminous coal. Among the first attempts to burn the screenings with coal was to mix the two together, but they had a tendency to segregate in the bunker. By the time the fuel reached the boiler, it might at one instant be high in coke and at another time the coke content would be low. This made satisfactory combustion almost impossible. The method adopted keeps the coal and coke separate until they reach the stoker rams.

This mixture of coal and coke screenings is the fuel burned in the boiler house that supplies steam to the company's new power plant. The boiler plant has eight horizontal water-tube boilers, each containing 9,770 sq.ft. of heating surface. On four of the boilers the steam condition is 200 lb. gage and 125 deg. F. superheat; the other four operate at a steam pressure of 175 lb. and 125 deg. superheat. The latter supply steam to the rolling-mill engines on near-by mills, and the four high-pressure units deliver steam to the turbine in the new power house. They are fired by 12-retort underfeed stokers with an actual grate area of 156 sq.ft. each. From the stoker to the nearest tube is 12 ft. 6 in., and the combustion volume of the furnace is 3,725 cubic feet.

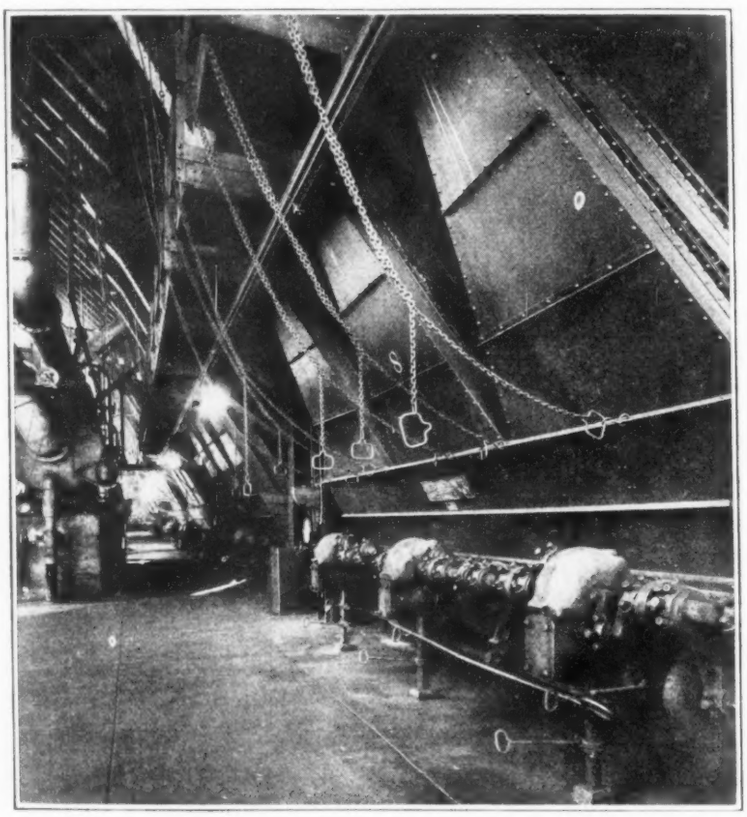


Fig. 1—One group of four boilers operates at 200 lb. and 125 deg. F. superheat and four others operate at 175 lb. and 125 deg.

Each group of four boilers connects to a common header. These headers are connected by a large U bent, and an automatic valve is installed between these headers so that when the steam pressure rises above a predetermined limit on the power-house boilers, the automatic valve

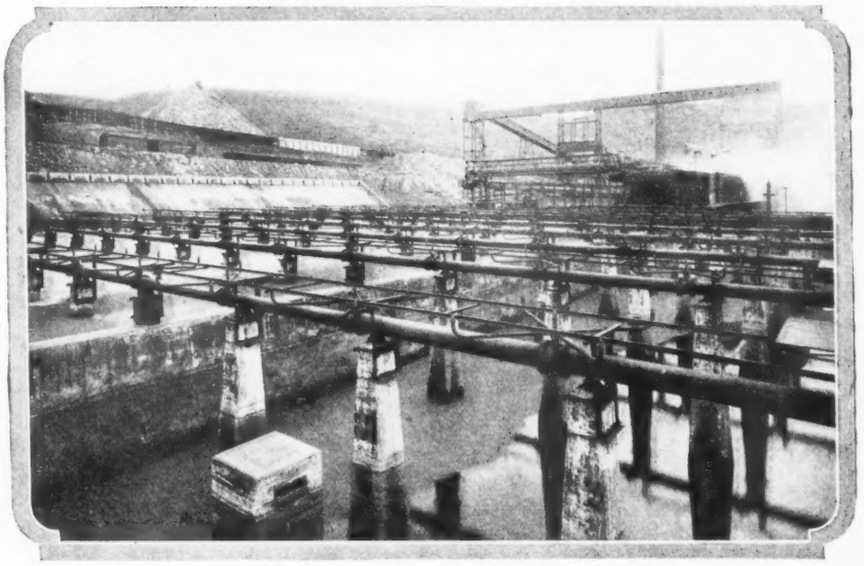
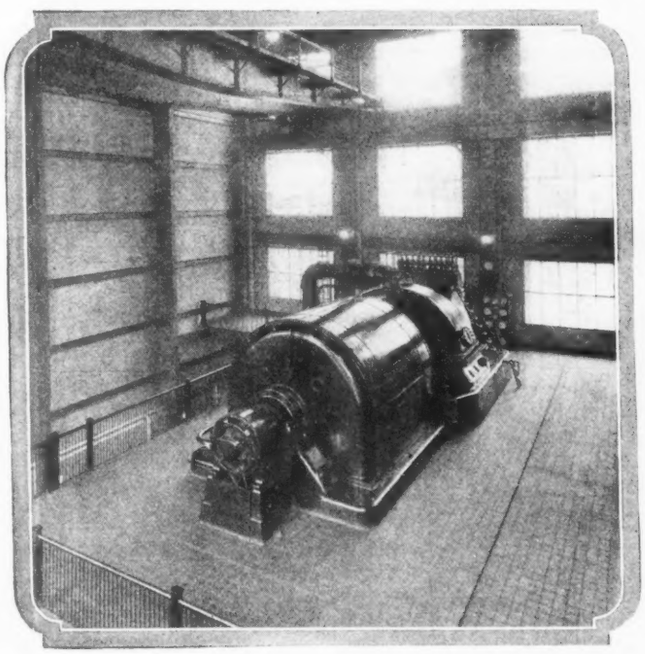


Fig. 2 (Right)—Spray pond for 18,750-kva. turbine's condenser, has 9 lines of pipe supplying 600 jet nozzles, is used during periods when it is necessary to conserve the water supply to the works

Fig. 4 (Below)—Switchboard room has been located on the same level and adjacent to the turbine room to obtain a convenient operating arrangement



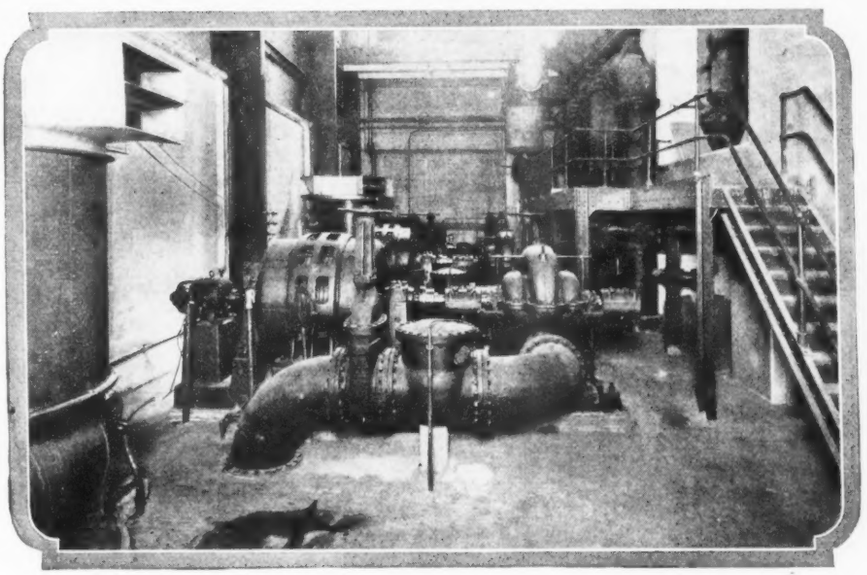


Fig. 3 (Above) Turbine-room floor is open on two sides so that all heavy equipment may be readily handled with the overhead crane

Fig. 5 (Left)—Three 12,000-gal. per min. circulating pumps, used only when the cooling pond is in operation, are driven by 6,600-volt synchronous motors

opens and allows steam to pass to the mill engine line. This results in flexible operation. Both groups of boilers are designed for the same steam pressure, but the steam pressure required for the rolling-mill engines is lower than that for the turbine.

Coal for this plant, as for the rest of the works, is received from the company's mines near the plant. From the cars the coal is dumped into a track hopper and is taken to the top of the boiler house by two semi-automatic skip hoists. From here it is delivered to the bunker by a shuttle belt conveyor. The coal is passed through a crusher at the mine and receives no further treatment at the plant. The coke screenings are received and handled in the same way as the coal. A divided bunker is used, and the conveyor is equipped so that it will deliver the coal to one side of the bunker and the coke to the other. As shown in Fig. 6, the coal side of the bunker is constructed of steel without any lining, whereas on the coke side a concrete lining has been installed. The object of this lining is to prevent the erosive action of the coke, since coke is highly abrasive. The bunker walls have been carried all the way to the roof to prevent the coal and coke dust from getting into the boiler plant proper.

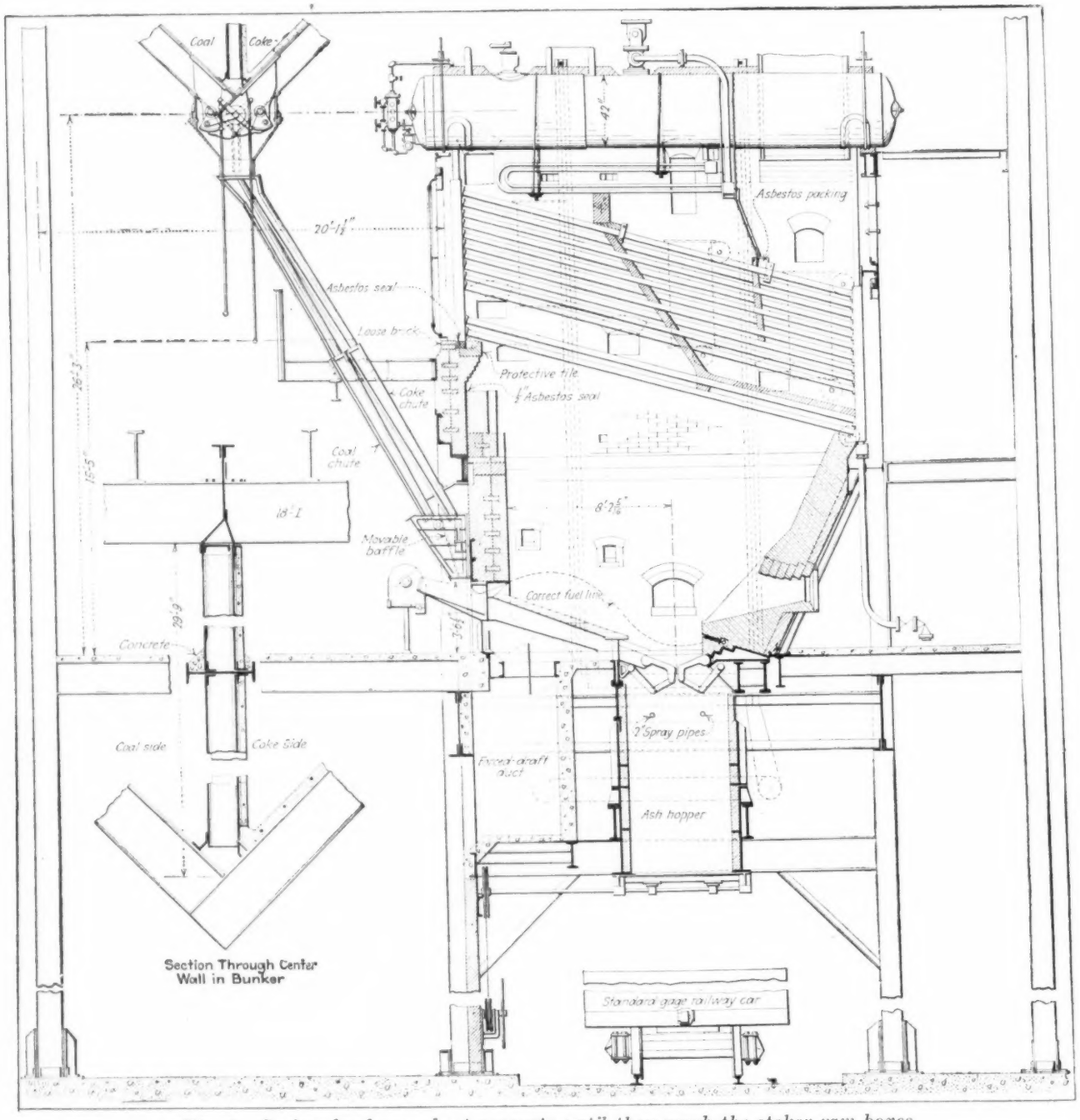


Fig. 6—Coal and coke are kept separate until they reach the stoker ram boxes

From the bunker the coal and coke are led to the stoker hoppers through double chutes, as indicated in Figs. 1 and 6. The chutes next to the boilers contain the coke and the rear chutes carry the coal. As can be seen in the figure, the chutes lead to opposite sides of a movable baffle plate in the stoker hopper, so that

the two fuels do not come into contact until they reach the ram boxes. The ratio between the amount of coal and coke fed to the stokers is controlled by the position of the baffle in the hopper. Under normal operation this ratio is about 50 per cent coal and 50 per cent coke. This ratio is varied somewhat according to the quantity of coke available. Economizers equipped with soot blowers are installed.

Each boiler has a turbine-driven forced-draft fan discharging into a concrete air box underneath each stoker, and a turbine-driven induced-draft fan, which discharges into a short stack. Automatic combustion control is provided. In this system the speed of the forced-draft fans and stokers is varied by small changes in steam pressure due to the increase or decrease in load, and the induced draft is controlled from furnace pressure.

When burning coal only, the stokers and draft equipment are capable of operating the boilers continuously at 300 per cent rating. With a 50-50 coal and coke mixture a continuous rating of 250 per cent can be maintained. As high as 66 per cent coke has been burned, but the best mixture is 40 per cent coke and 60 per cent coal. As previously stated, however, the mixture is regulated to a certain extent according to the amount of coke available.

So far as the operation of the boilers is concerned, they respond about as readily with the mixed fuel as with coal. Everything considered, the operation has proved satisfactory, and means have been provided for utilizing a byproduct material.

All auxiliaries in the boiler plant are steam-driven. Their exhaust goes to the feed-water heaters and the evaporators. The latter furnish makeup feed water for the four boilers supplying steam to the new power house. The condensate from the power house goes through the evaporator condensers and then to the feed-water storage tanks.

The four boilers used on the mill engines are supplied with raw water. Barometric condensers are used on these engines, consequently there is no return to the boilers. The feed for these boilers, which is water from a reservoir, is treated within the boiler by a continuous process by which the solids are removed as fast as they are formed.

Turbo-Generator Plant

The power house is about 1,000 ft. away from the boiler plant, and the two are connected by an 18-in. overhead steam line carried on a steel bridge. On account of the congested condition of the district it was necessary to locate the power house separate from the boiler plant. The present power plant contains one 18,750-kva. unit operating at 1,500 r.p.m. Space is available for extending the building for two more units of the same size as the one installed.

Part of the time, when there is a scarcity of condensing water, a cooling pond is operated. When there is a surplus of water, the condensers operate on the general supply for the works. The layout of the circulating-water system is shown in Fig. 7. There are two sources of supply, one from the south fork of the Conemaugh River about seven miles away, and the other a reservoir on the Quemahoning River about eleven miles distant, the latter being connected to the works with a 66-in. line. When there is not a surplus of water, the condenser of No. 3 plant is operated on the cooling pond. This is the only time that the circulating pumps are operated. The spray pond is in operation about five months per year, and this for the most part is in the summer. Three circulating pumps are provided, and these are driven by 6,600-volt synchronous motors.

During periods when there is plenty of water, the cooling water for the generator air cooler, oil cooler and air ejectors goes to the river. When the cooling pond is in operation, the cooling water for the auxiliaries is returned to the pond as makeup, by the circulating pumps.

The generator is rated at 15,000-kw. at 80 per cent power factor and is designed for 6,600 volts, three-phase, 25 cycles. To insure clean ventilating air for the cooling of the machine, it is equipped with a closed system of ventilation. Raw water is used in the air coolers.

On account of the large number of synchronous motors in the mills, the power factor of the system is

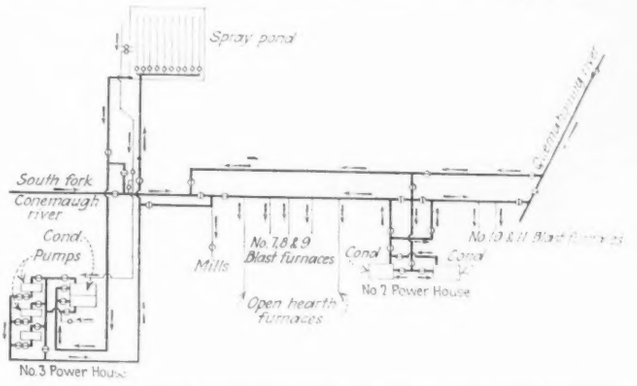


Fig. 7—General arrangement of mill- and condenser-water supply piping

high, about 98 per cent lagging. The turbine capacity is sufficient to operate the generator at full kva. rating and unity power factor. As this is the most efficient unit on the system, the other generators are made to carry the wattless current and the new machine is operated at about 18,000-kw. unity power factor load for 20 hours a day.

The plant has been designed in accordance with the best central-station practice to insure continuous operation. One feature that is frequently overlooked in the design of large industrial plants, is that the operating conditions may be as severe or even more so than in large central-station practice. If an electrical failure occurs, it will in all cases be close to the power house and because of the low resistance of the lines the in-rush current into the fault will be high. On this system the plants tie into a double overhead 1,000,000-circ.mil line. This line, being of short length, has a very low resistance, and it is estimated that under the present set-ups of the system it is possible to have 60,000 amperes fed into a short-circuit on the 6,600-volt line. With two more units installed in the new plant, this short-circuit current may reach 80,000 amperes, and the system has been designed and equipment installed to stand the mechanical and electrical stresses resulting from such large currents.

Insulation for 15,000 volts has been used throughout, and the phases in the power house are isolated by a vertical arrangement. This is the first time that an isolated-phase construction has been used in a steel-mill power plant.

The plant was designed and constructed by the Cambria Works engineering staff.

Steam Rates and Thermal Economy

TWENTY or thirty years ago it was common to compare the performance of steam engines on the basis of their respective steam rates, and this practice was somewhat justified. A widely used expression for the brake thermal efficiency of steam prime movers is:

$$\textit{Brake thermal efficiency} = \frac{2{,}545}{W_b \times Q_1}$$

where W_b is the brake steam rate in pounds per brake horsepower-hour, and Q_1 the heat supplied per pound of steam. If the steam rate on the kilowatt-hour basis is used, the factor 2,545 becomes 3,413. From this formula it is obvious that the steam rates of two prime movers are inversely proportional to their respective thermal efficiencies only in case the heat supplied each per pound of steam is the same.

If the prime movers being compared are supplied with steam at the same pressure and temperature, exhaust at the same back pressure and do not operate under reheating or regenerative principles, their steam rates are then inversely proportional to their thermal efficiencies. About 1900 the diversity of pressures and temperatures encountered was much smaller than at present, and engines were usually supplied with dry-saturated steam at a pressure of about 100 lb. per sq.in. abs. These engines were operated either non-condensing with about atmospheric back pressure or condensing with a vacuum of approximately 26 in. of mercury. Under such circumstances it was fairly safe to assume that the relative steam rates of two condensing or of two non-condensing engines was an inverse measure of their relative economies.

However, with the adoption of higher steam pressures, higher steam temperatures and new cycles of operation, the field has so extended that it is unusual to find two installations whose performance may be compared by the steam rates. In addition to the steam rate it is becoming more and more essential that thermal efficiency also be quoted in order that the real performance of a plant may be known.

A numerical example may assist in making this point clearer. Suppose two turbine engineers compare notes on the performance of their respective units, which are of about the same size. In both plants the steam is supplied the turbine at an absolute pressure of 200 lb. per sq.in. and superheated 200 deg. F. Engineer A reports that his turbine, operating condensing, shows on test a best steam rate of 14 lb. per b.hp.-hr. with an absolute back pressure of 2 in. of mercury. Engineer B says that his turbine has a best steam rate of only 15 lb. per b.hp.-hr. when operating with the normal back pressure of 15 lb. per sq.in. abs. Although A can show the lower steam rate, is his the better turbine?

For the steam conditions given the heat supplied to the turbine in engineer A's plant per pound of steam is 1,238.8 B.t.u. From the equation quoted, the brake thermal efficiency is $\frac{2{,}545}{14 \times 1{,}238.8} = 14.7$ per cent. Engineer B's plant has a quantity of heat supplied equal to 1,126.8 B.t.u. per lb. and the corresponding brake thermal efficiency is $\frac{2{,}545}{15 \times 1{,}126.8} = 15.1$ per cent. Thus the plant with the higher steam rate has also the higher thermal efficiency. It uses more steam, but is nevertheless the more efficient.

The Effect of Reheating

It is also interesting to see the effect of a change in the cycle of operation. To the engineer who is accustomed to think of steam rates of simple Rankine cycle turbine plants, a steam rate of 7.5 lb. per kw.-hr., with no radical steam conditions, seems much out of line. However, in a reheating power plant such a rate for the turbine generator set would not be impossible. The answer to such an apparent anomaly lies in the fact that the heat supplied per pound of steam is appreciably higher. This is due to the reheating.

For example, suppose steam is supplied to a turbine at a pressure of 500 lb. per sq.in. abs. and a temperature of 700 deg. F., the back pressure being maintained at 1 in. of mercury absolute. Although the unit is arranged for reheating, it may be operated without reheating and then shows a steam rate of 9 lb. per kw.-hr. When the steam is taken from the turbine at 120 lb. per sq.in. absolute, reheated to 700 deg. F., and returned to the turbine, this steam rate drops to 7.5 lb. per kw.-hr., a decrease of 16.7 per cent.

The thermal efficiency, however, has not increased in anything like this proportion. Without reheating, the heat supplied per pound of steam is 1,307 B.t.u. With the steam rate quoted, this gives a combined[1] thermal efficiency of $\frac{3{,}413}{9 \times 1{,}307} = 29$ per cent. With reheating, 134 B.t.u. per lb. of steam is supplied in the reheater in addition to the 1,307 B.t.u. per lb. from the main boilers. Thus, the combined efficiency becomes $\frac{3{,}413}{7.5\ (1{,}307 + 134)} = 31.5$ per cent. The increase in the thermal efficiency of the unit due to reheating is 8.6 per cent of the lower value.

In the case of the power unit in a regenerative plant, in which steam is bled from the main unit for heating the feed returning to the boilers, the steam rate when operating bleeding is higher than when operating straight condensing, because less energy is available from the steam that is bled than would be available were it expanded to condenser pressure. On the other hand, the thermal efficiency when operating with bleeding is higher than when operating straight condensing. Thus, it is perfectly possible to compare two plants, one operating on the regenerative principle and the other straight condensing and find that the units in the first plant have both the higher steam rate and the higher thermal efficiency.

In its proper place the steam rate is still a valuable figure. From the known or estimated load on a unit and the steam rate, a rate of flow can be found that may be useful in specifying the size of the boiler or the condenser for serving the unit, the size of the pipe lines, etc., but for comparing the efficiency of various plants, the steam rate is becoming less significant as the use of steam becomes more complicated.

[1] The thermal efficiency of the unit, comprising the turbine and the generator.

New Field for Desuperheaters

Opened by Changed Steam Conditions in Plant Extensions

By B. N. BROIDO*

BY USING a desuperheater and reducing valve in the tie line between the new and old sections of a plant, an emergency connection can be maintained while taking advantage, in the new section, of recent advances in steam temperature and pressure. The article describes the operation of a new type of desuperheater in which no water comes in contact with the steam.

THE advantages of high steam pressure and temperature for power generation are now universally recognized. In many plants, operated at comparatively low pressure and temperature, new extensions are designed for high pressure and high superheat. In order to make the operation more flexible and use the new boilers in connection with the existing equipment, desuperheaters are applied. In a desuperheater, with water as a cooling medium and in connection with a reducing valve, the temperature and pressure of the steam is lowered, so it can be supplied to the low-pressure equipment.

When steam is used for generating power, whether in reciprocating engines or in turbines, it is important, in the writer's opinion, that no water should come in contact with steam, so that the steam cannot by any possibility carry any water to the engine.

Both manufacturers and operators recognize the importance of having steam enter a turbine or engine at a constant temperature, independent of the load variation. From an economical point of view it is advisable, at all loads, to operate a steam prime mover, with the highest temperature for which it is designed.

Only a few years ago the superheaters in water-tube boilers were located practically exclusively between the first and second gas passes. The superheat obtained in this location varied with the rating of the boiler. In an endeavor to obtain constant temperatures, special temperature regulators were designed in Europe, which would reduce the temperature of the steam at high ratings, when the superheat became excessive. It was soon recognized that the best arrangement for absorbing heat from the steam and thus reducing the superheat, is the non-contact type of heat exchanger, with the water outside the tubes and the superheated steam inside.

Study of the heat transmission between superheated steam and water showed that the heat-transmission coefficient between steam and boiling water is much higher than between superheated steam and cold water. It is a well-known fact that the latent heat of a liquid is absorbed and also given up much easier than the sensible heat. Under favorable conditions of steam velocities and tube arrangement, boiling water can absorb from superheated steam, up to 200 B.t.u. per square foot per hour per degree F. temperature difference. Such a high heat transfer cannot be obtained between superheated steam and cold water. By using hot water, near the boiling point, corrosion trouble usually experienced when cold water is being heated in steel tubes, is eliminated.

The company with which the writer is connected has adapted this principle to the design of desuperheaters for reducing the superheat of steam when required.

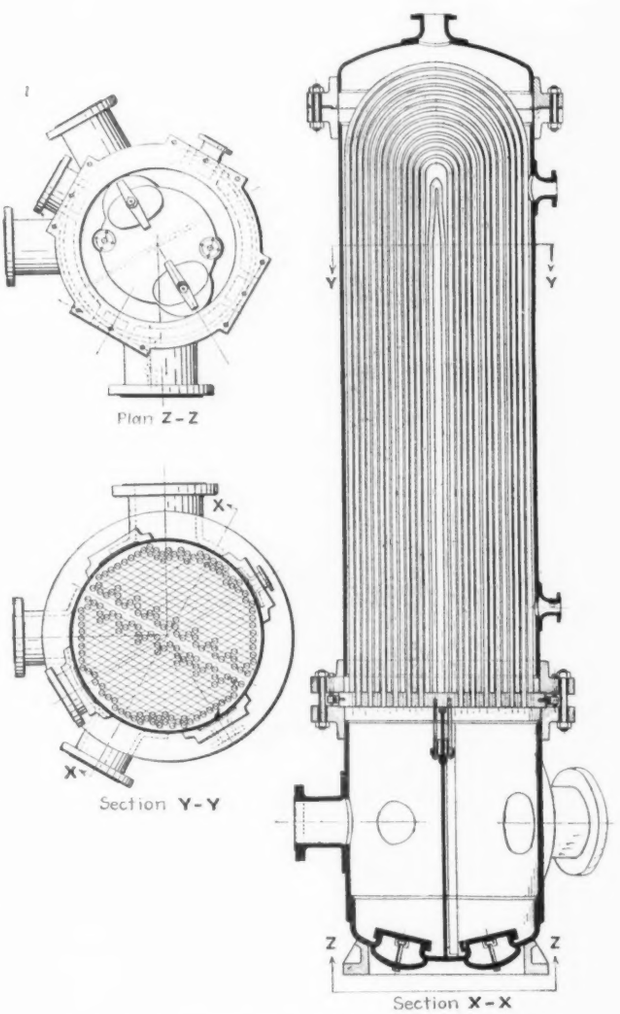


Fig. 1—Cross-section of non-contact type of desuperheater

*Consulting Engineer, The Superheater Co.

Fig. 1 illustrates a desuperheater of large capacity. It consists of two parts—a steam chest for the superheated steam, divided in two parts by a partition, and a drum for the cooling water, in which are installed a number of U-tubes, connecting both parts of the steam chest.

The steam enters at one side of the partition, passes through the U-tubes, where it gives up its excessive superheat to the water, and leaves the desuperheater from the other side of the partition. With this arrangement each tube can expand individually. This is an important factor in connection with a desuperheater, since due to a possible difference in temperature of the superheated steam, all tubes may not expand equally. Only the theoretically necessary amount of water to absorb the additional heat is vaporized in the desuperheater. As the superheated steam does not come in contact with the cooling water, the velocity of the steam cannot be imparted to the water and any possibility of damage by water, to the engine or turbine, or in the pipe line, is definitely eliminated.

Where steam from a new high-pressure boiler is to be used for existing engines continuously, the drum of the desuperheater is connected directly both with the water and the steam space of the boiler. The desuperheater is always under boiler pressure, and the water flows to it from the boiler by gravity. The steam generated by the heat absorbed from the highly superheated steam in the desuperheater, is returned to the steam space in the boiler. Fig. 2 shows a typical arrangement of a desuperheater in direct connection with the boiler. The water drum of the desuperheater can be connected with either the high-pressure or low-pressure boiler. Since the temperature difference between the superheated steam and the water of the low-pressure boiler is greater than that between the steam and the water in the high-pressure boiler, a smaller desuperheater is required if the water is taken from the low-pressure boiler and the steam generated in the desuperheater is also returned to that boiler.

There are a number of power plants, particularly large ones, where new high-pressure boilers and turbines are installed in addition to the existing equipment operated at lower temperature and pressure. Normally, each battery of boilers furnishes steam for the prime mover built for the corresponding pressure. In emergency cases, however, the high-pressure boilers may be called upon suddenly to supply steam for the low-pressure equipment. In this case desuperheater and reducing valve must be put into operation promptly, to prevent the steam reaching the low-pressure turbine in a highly superheated state. In order that no great amount of water may be taken from the boiler suddenly, it is advisable to arrange an auxiliary drum to supply the necessary cooling water to the desuperheater. When the desuperheater is put in operation, it is filled with water from that auxiliary drum. The steam outlet of the desuperheater is connected to the auxiliary drum, as well as to the boiler, thus the steam flows to the boiler, while, at the same time, the auxiliary drum is kept at the boiler pressure. Fig. 3 shows a typical arrangement of a desuperheater with auxiliary drum.

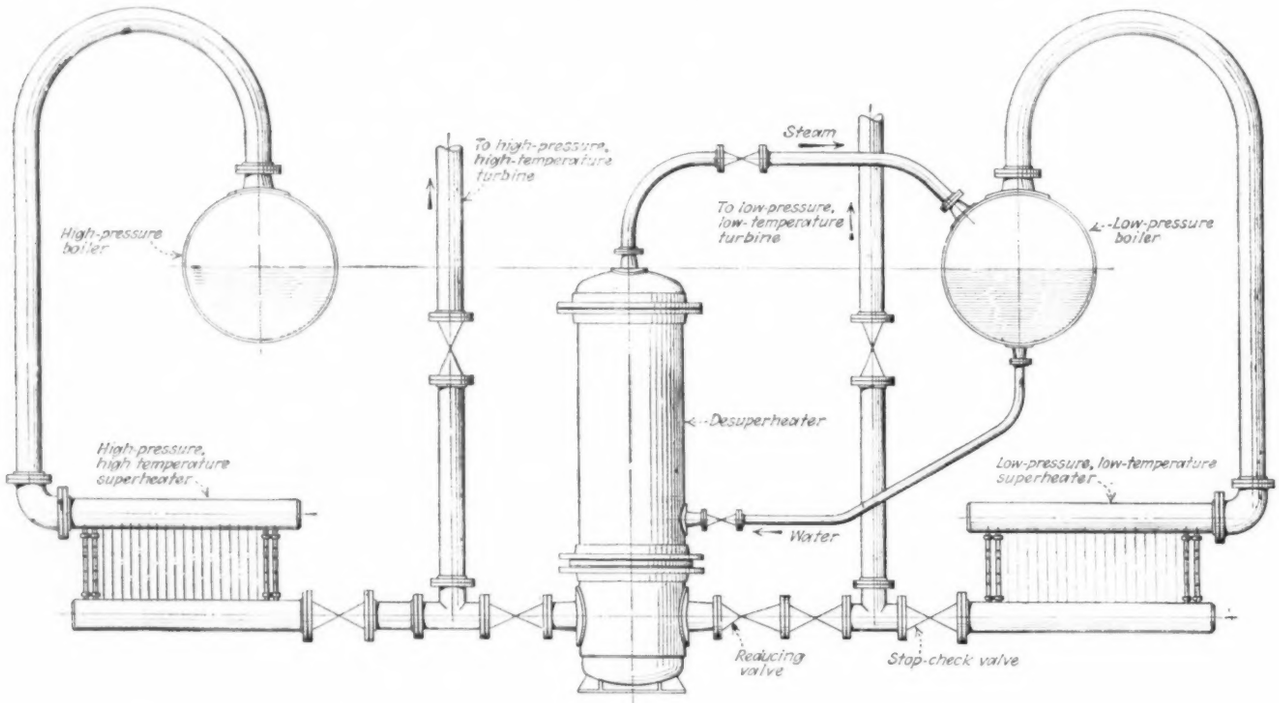


Fig. 2—Diagram showing method of tying together high-pressure and low-pressure systems

In the Hudson Avenue station of the Brooklyn Edison Company, Brooklyn, N. Y., there are 12 boilers and three 50,000-kw. steam turbines operated at 280 lb. pressure. A new 80,000-kw. turbine and four boilers operating at 400 lb. pressure have been recently installed. A desuperheater of the type illustrated in Fig. 1, and an auxiliary drum, will be connected between the old and the new steam lines so that steam from the high-pressure boilers can be used in the low-pressure turbines. In this case the desuperheater is designed to reduce 950,000 lb. of steam from 725 deg. F. to 640 deg. F. Two 12-in. reducing valves reduce the pressure from 400 lb. to 280 lb. The final temperature of the steam is then 630 degrees.

It is, of course, imperative to have the desuperheater so arranged that a constant superheat will be obtained at all times independently of both the amount and temperature of steam passing through the desuperheater. The regulation with the non-contact type of desuperheater is perfect. The water level in the desuperheater can be maintained corresponding to the amount of heat to be absorbed at the various conditions of operation. This can be accomplished either by regulating the valve in the water line, limiting the amount of water to be evaporated, or still better, by regulating the steam valve in the line carry steam from the desuperheater to the boiler. If more steam is taken from the desuperheater than is generated, the pressure will be reduced and the water level will rise. In closing the valve, so that less steam can escape than is generated, the pressure will increase and the water level drop. The regulation

Power From the Ocean's Heat

Various methods for obtaining power from inexhaustible sources, such as the tides, are being offered. Georges Claude, originator of one method of liquefying air, in a lecture before the French Academy of Science demonstrated a process he has evolved of generating power from the warm water of the tropical ocean. He stated that in tropical regions the ocean waters consist of two layers. To a depth of about 3,000 ft. the temperature remains steadily all the year round between 80 and 90 deg. F. Below that the temperature falls to about 35 deg., or a little above the freezing point.

He would introduce the warm surface water into a vessel and allow it to evaporate under a slight vacuum. The resulting steam would then flow to a turbine and after use would be rejected into a condenser. This con-

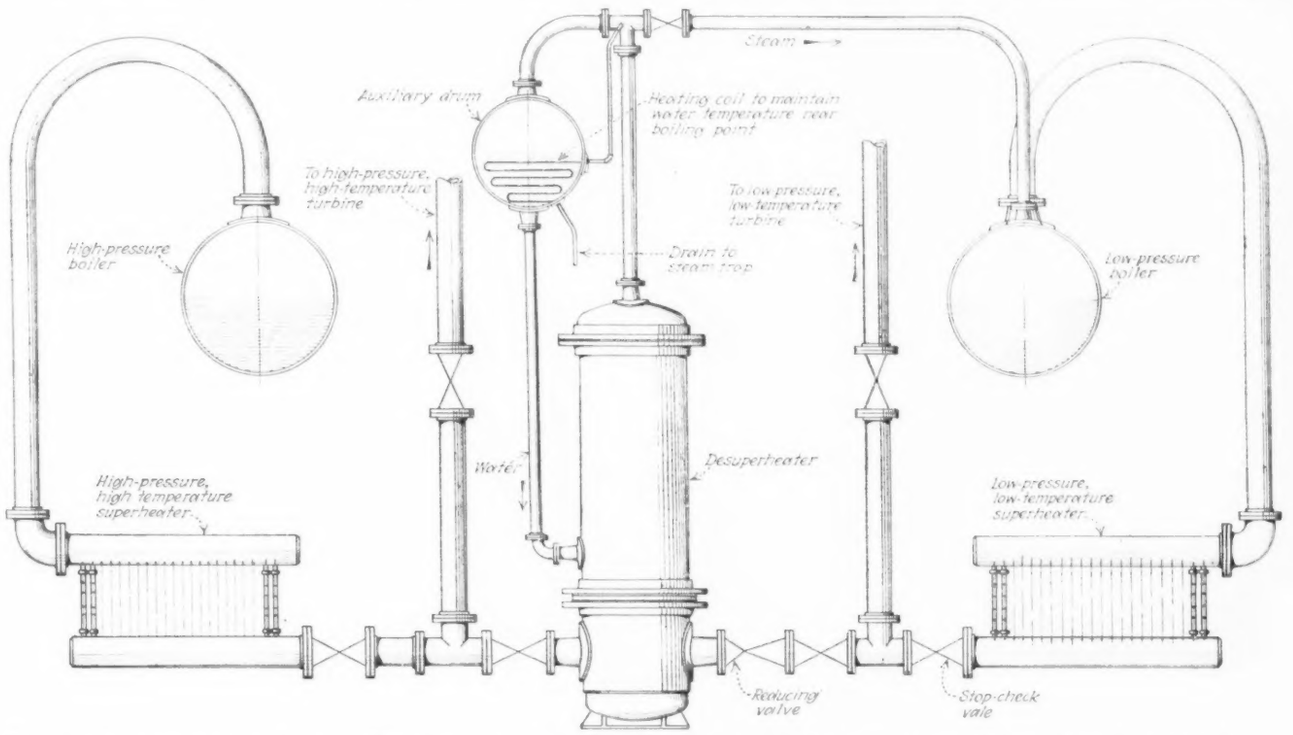


Fig. 3—Arrangement similar to Fig. 2 except that water supply is stored in special auxiliary drum to prevent sudden drain on drum of low-pressure boiler

can be made automatically, by inserting a thermostat in the discharge line of the desuperheater which would cause either the water or the steam valve to open or close.

When the temperature of the superheated steam coming from the high-pressure boiler is reasonably constant, the regulation can be made still more positive by utilizing the pressure difference of the superheated steam in the main line before and after the desuperheater. This pressure drop will correspond to the amount of superheated steam flowing through the desuperheater and can be made to actuate either the water or the steam valves.

The non-contact type of desuperheater can also be applied advantageously in plants where steam is to be desuperheated for process work. Many chemical processes require a constant temperature; water in the steam is very often undesirable. In such cases the non-contact type of desuperheater will best meet the situation.

denser would receive its cooling water through a long pipe having its intake within the zone of the cold water. The discharge would be at an equal depth, so the pumping pressure would need be only enough to overcome piping friction and the difference in the densities of the two water columns.

WITH HIGH-TEMPERATURE STEAM the piping forms a considerable part of the total cost of the plant, and it is, therefore, important from the viewpoint of economy, that this item be carefully considered. The pressure drop, due to friction, the radiation loss and the initial cost must be considered in arriving at the most economical size. Different combinations in which the boilers and prime movers may operate should be studied, in order that the runs may be as short as possible and all necessary bends and valves may be eliminated. A careful analysis of all piping layouts will show worthwhile returns in investment saved.

Results with Unit Pulverizers at Cahokia

With Neither Air Preheater Nor Economizer and Burning Undried Coal Having 9 per Cent Moisture and 15 per Cent Ash, This Unit Mill Installation Gives Boiler Efficiencies of 82 to 85 per Cent

By E. H. TENNEY
Chief engineer of power plants, Union Electric Light & Power Company, St. Louis

FOLLOWING the successful application of unit pulverizers to the boilers in the Ashley Street Station of the Union Electric Light & Power Company at St. Louis, there was an opportunity during the summer of 1926 to divert temporarily two of the mills, purchased for installation at Ashley Street, to Cahokia Station, where they were installed for experiment and observation on one of the 18,000-sq.ft. boilers. This boiler has been operating for about two years on powdered fuel supplied from a storage system.

It was the purpose of this experimental installation to ascertain by careful observation and tests what performance might be expected from this boiler when equipped with unit mills using undried coal and horizontal firing, as compared with previous performance of the same boiler with the storage system, using dried coal fired vertically.

Each of the two unit mills used on these tests had capacity to deliver 8,000 lb. of wet coal per hour. Together they supplied sufficient coal to permit of operation at a maximum capacity approximating 230 per cent of rating. No tests were run, therefore, at ratings in excess of this figure.

Firing equipment used was as follows: Four 42-in. semi-turbulent horizontal burners of the type used at Ashley Street Station, arranged for induced secondary air through air-deflecting vanes. These burners were set in line in the front wall of the boiler 7 ft. above the general elevation of the water screen and directed downward at an angle of 5 deg. from the horizontal toward the rear wall of the Murray fin-tube furnace. This furnace has fin tubes on both side walls and back wall, and a bare tube water screen over the ashpit.

The location of the two pulverizers was on the basement floor beneath and in front of the boiler. The two outer burners were connected to one mill and the two middle ones to the other. The secondary air vanes in the burners were so placed as to give clockwise rotation to the coal and air from the two right-hand burners and counter-clockwise rotation from the two left-hand burners.

The boiler is equipped with neither air preheater nor economizer.

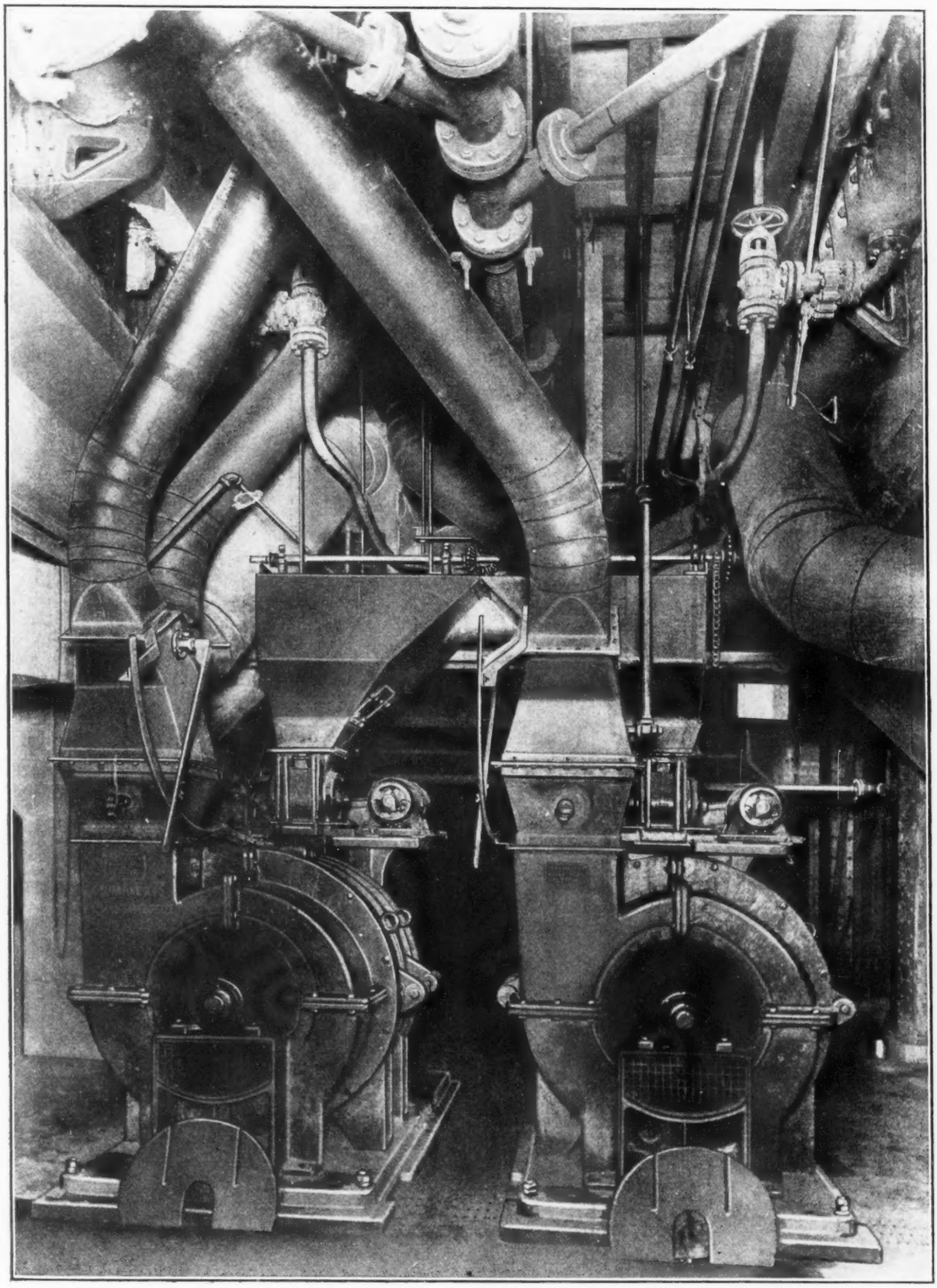
Three 24-hour runs were made at ratings of 189, 219 and 228 per cent with respective efficiencies of 85.04, 83.07 and 82.03 per cent; flue gas temperatures of 492, 507 and 515 deg.; CO_2 at the top of third pass, 15.2, 14.0 and 14.3 per cent; and a total steam temperature of 656, 652 and 663 deg.

The fuel used was undried coal from the Kathleen mine of the Union Colliery Co., Dowell, Ill., which is the coal used regularly in the station. Its high percentage of ash, which varies considerably with the grade of the screenings and which fuses at low temperature, makes the use of this coal much more difficult than is the case with higher-grade fuels.

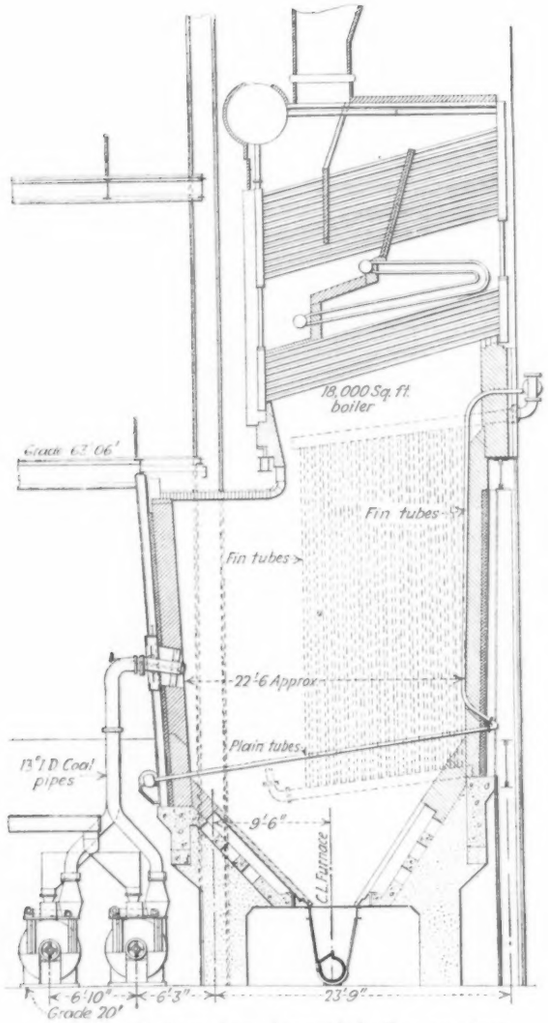
In certain respects the furnace conditions were so radically different from those of previous operation that they assume considerable importance. Furnace tem-

TEST RUNS WITH UNIT MILL AT CAHOKIA

Boiler	B & W cross drum					
Mills	Simplex					
Water-heating surface of boiler, sq.ft.	18,010					
Furnace water cooling surface, sq.ft.	1,888					
Superheating surface, sq.ft.	4,070					
Murray fin-tube furnace, cu.ft.	13,500					
No economizer or air preheater employed	Natural draft,					
General:						
Run No.	1		2		3	
Date, August, 1926	11–12		4–5		6–7	
Duration, hours	24.15		24.00		24.50	
Kind of coal	Ill. Screening, Kathleen Mine					
Pressures and Drafts:						
Steam press., abs., lb. per sq.in.	332.8		328.8		333.1	
Barometric press., in. hg	29.77		29.66		29.71	
Draft at gen. tubes, in. H_2O	0.04		0.016		0.02	
Draft at burners, in. H_2O	0.16		0.265		0.22	
Uptake draft, in. H_2O	0.37		0.69		0.73	
Temperature:						
Temp. of steam, deg. F.	656.0		651.9		663.0	
Superheat, deg. F.	228.9		226.0		235.8	
Temp. of feed water, deg. F.	202.2		202.7		202.3	
Flue-gas temp., deg. F.	492		507		515	
Firing Data:						
Gas analysis, per cent by vol., top third pass carbon dioxide	15.2		14.0		14.3	
Oxygen	3.5		4.4		4.6	
Carbon monoxide	0.0		0.0		0.0	
Nitrogen	81.3		81.6		81.1	
Proximate Analysis:						
Volatile, per cent	33.74		33.50		33.90	
Fixed carbon, per cent	41.77		43.01		41.71	
Ash, per cent	14.91		14.04		16.04	
Moisture, per cent	9.58		9.45		8.35	
Heat value per lb. as fired, B.t.u.	10,359		10,696		10,671	
Average Fineness:						
Mill No.	1	2	1	2	1	2
Per cent through 40 mesh	97.9	98.7	97.4	98.1	97.2	98.6
Per cent through 60 mesh	95.3	96.8	95.1	95.6	95.3	96.9
Per cent through 80 mesh	91.7	94.6	93.1	93.3	92.7	94.7
Per cent through 100 mesh	81.8	88.7	83.2	83.5	82.3	87.3
Per cent through 200 mesh	61.6	73.8	62.2	64.0	61.7	67.0
Combustible in ash, per cent	3.7		6.9		5.2	
Economies and Results:						
Per cent rating, boiler only	189.3		219.4		228.4	
Water evap. per lb. coal, lb.	7.545		7.633		7.483	
Equiv. evap. f. & a. 212	9.069		9.160		9.024	
Efficiency of boiler, per cent	85.0		83.1		82.0	
Coal per cu.ft. comb. space per hr., lb.	0.961		1.102		1.165	
B.t.u. per cu.ft. comb. space per hr.	9,955		11,791		12,433	
Kw.-hr. to mills per ton coal milled	18.63		17.36		16.38	

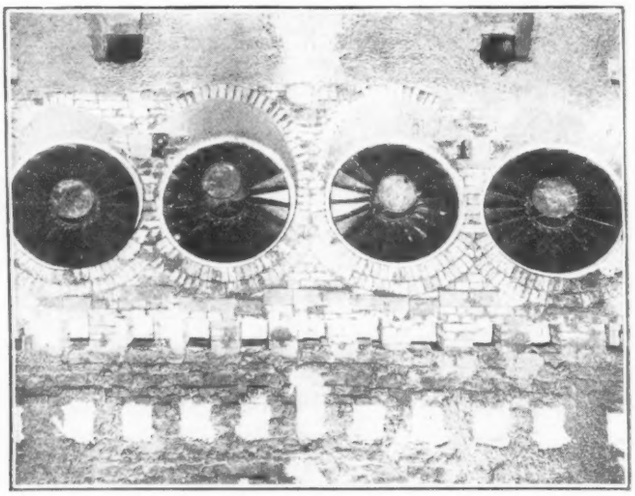


Unit mill installation serving 18,000-sq.ft. boiler at Cahokia



Sectional elevation through boiler setting

peratures were notably lower, and the ashpit was sufficiently cool to prevent slagging. The ash retained a sandy granular consistency and was easily removed by the ash sluice. These lower pit temperatures are accounted for by the manner in which the horizontal burners spread pulverized coal and air across the bottom of the furnace, thereby shadowing the pit from the intense radiant heat of the upper furnace. As a result no slag formed either on the water screen or in the pit. This seems to be a practical way of eliminating one



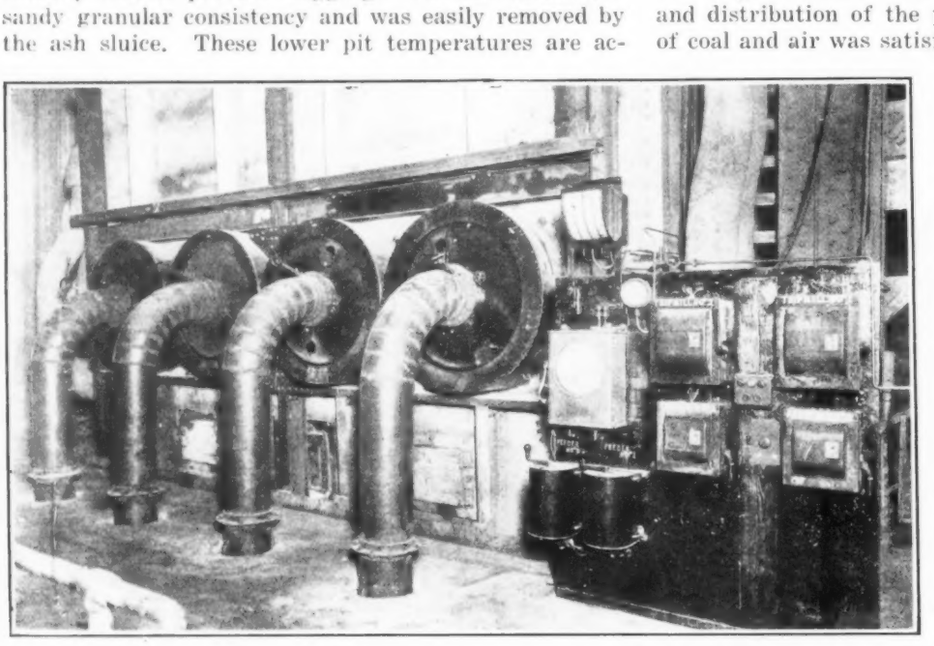
Looking at burners from within the furnace

of the most troublesome problems of operation where low-grade coal is burned at high ratings.

As the furnace was designed for vertical firing, it obviously was not perfectly suited to the horizontal system. By their cooling action the side and rear water-cooled walls held down the furnace temperatures to a point that interfered to some extent with perfect combustion. This was evidenced by the presence of combustible in the fly ash and also by a lowering of about 20 deg. F. in the temperature of the outgoing steam. Undoubtedly, more refractory surface and less cold surface in direct contact with the turbulent flame would have remedied these conditions.

The performance of the burners as to flame control and distribution of the proper mixtures and velocities of coal and air was satisfactory, and enough experience was obtained in these adjustments to insure the possibility of sufficiently flexible operation to care for all ratings. The absence of stratification of the gases was noticeable. At all times during the runs it was possible to operate smokelessly. A slight erosion of the uncooled front wall between the burners and arch was noticeable after 200 hours.

The feasibility of burning undried coal in a large setting was demonstrated, and if allowance is made for the furnace design being imperfectly suited to the experiment, it would appear that undried coal from unit mills can be burned at nearly the same efficiency as dried coal from the storage system.



Boiler front showing burners and control board

Are Reduced-Voltage Starters Necessary on Alternating-Current Motors?

By T. H. ARNOLD
Electrical Engineer, Southwestern Portland Cement Company, Osborn, Ohio

UP UNTIL recently it has been general practice to use reduced-voltage starters on induction motors of over 5-hp. capacity, and the power companies have rigid regulations regarding the starting of such motors. In this article the across-the-line starter is discussed and the experience given with this type on a large number of motors ranging up to 500-hp. capacity and for potentials up to 2,200 volts, supplied from a generator capacity of 4,500 kilowatts.

AN ANALYSIS of the underlying reasons for the reduced-voltage starters for alternating-current induction motors will reveal that in the development of systems and apparatus we have largely outgrown the necessity for this equipment in heavy-power industries. In the early development of the alternating-current motor the generating plants were small and the feeder lines subject to high voltage drops. Voltage regulation was difficult, and the starting of motors caused serious disturbances. Motor construction was such that, except in the smaller sizes, damage to the motors was to be expected ultimately from throwing them directly across the line. Various forms of reduced-voltage starters were developed and have been retained as standard equipment with induction motors. The power companies place rigid specifications on the type of equipment to be connected to their lines. These restrictions are to prevent undue voltage drops and are in effect upon practically all systems.

The engineers of the heavy-power industries realized that both the first cost and the maintenance cost of reduced-voltage starters was high. Many of these plants generated their own power and thus were free to experiment with simplification of starting equipment. Across-the-line starting was tried, and the resulting economies have induced a wide use of this type of apparatus.

Current Inrush Due to Full Voltage

If full voltage is applied to an induction motor, a high current peak and mechanical shock to the motor and the driven machine may result. The current peak at the instant of starting will depend upon the applied voltage and the impedance of the motor winding. With medium- and slow-speed commercial motors the current peak will vary from 2.5 to 3.5 times full load current, but with high-speed machines these peaks may reach 6 to 8 times full-load current. The duration of the peak will vary with the rate of acceleration of the rotor and will drop off to normal as the rotor reaches full speed. The effect of line drop is to decrease the magnitude of the peak and to increase its duration. If the generating equipment is small or too heavily loaded and the motor is of relatively large size, a reduction in frequency may result. In the average industrial installation the generators and feeders should be of such size that the effect on voltage and frequency will be negligible.

The mechanical shock resulting from the application of full voltage to the motor has a noticeable effect upon both the stator coils and the rotor. The excessive current in the stator coils has a tendency to spread the coil ends. This must be counteracted by the coil bracing in the construction of the motor. Impregnation of the coils will prevent internal coil troubles due to chafing of the insulation of the individual conductors. Both these troubles are prevalent in the motors in normal operation and are merely accentuated by across-the-line starting. Modern designs of heavy-duty motors have largely eliminated this defect. The effect upon the rotor is largely due to vibrations and heating of the rotor bars. These have a tendency to loosen the rotor bars and to crack the end rings. Again, the construction of the modern motors has very largely eliminated this difficulty.

Advantages of Across-the-Line Starting

The main advantages presented by the across-the-line type of starter are simplicity in construction, lower installed cost, ease in application, low maintenance cost and increased productive time of the driven machine.

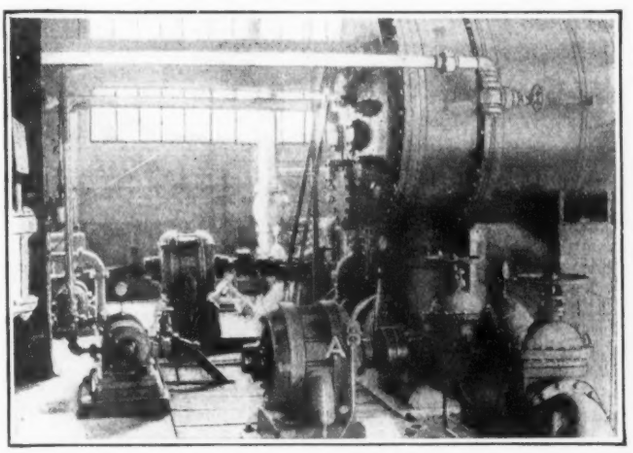


Fig. 1—Turbo-generator auxiliary motor driven pumps
Note push-button control on pump motor frame at A and the absence of starting equipment in pumproom.

With across-the-line starting the motor will have greater starting torque, thus will start readily under abnormal loads. Productive time lost from repairs to starting equipment will be materially reduced. Using magnetic-type starters will allow a saving of valuable space in the vicinity of the machines. The starters may be located on galleries or wherever space may be available without reference to machine location. With this

type, wiring costs may be reduced by banking the contactors, thus requiring heavy feeders at a few load centers in the departments.

Essentially, the only apparatus required for across-the-line type of starting are some means of closing and opening the motor circuit and providing protection to the motor against prolonged overloads. The following classification will cover the apparatus commonly used:

Method of Operation	Type of Switch	Motor Size, Horsepower	Voltage
Hand.....	Snap switch.....	One and less	110 to 220
Hand.....	Double-throw knife switch.....	10 and less	110 to 440
Hand.....	Carbon air-break circuit breaker.....	Any	110 to 440
Hand.....	Oil circuit breaker.....	Any	Any
Magnetic...	With plain contacts or contactor.....	5 and less	110 to 440
Magnetic...	Contactor with magnetic blowout...	50 and less	110 to 440
Magnetic...	Oil-immersed contactor.....	1,000 and less	2,200
Magnetic...	Oil circuit breaker.....	Any	Any

The table is offered as a general guide to be applied with due consideration of the horsepower of the motor and the voltage, as some of the larger motors in the groups with the lower voltages may have currents beyond the range of the apparatus mentioned.

Providing Overload Protection

Overload protection may be provided by the usual means. Fuses, while low in first cost, can be used only with a double-throw arrangement of starting and running fuses. The time delay in fuse replacement and the replacement cost are serious factors. Some forms of thermal relays allow a time element in starting, but have a time delay in replacement. The newer forms have largely eliminated the delay element. The time

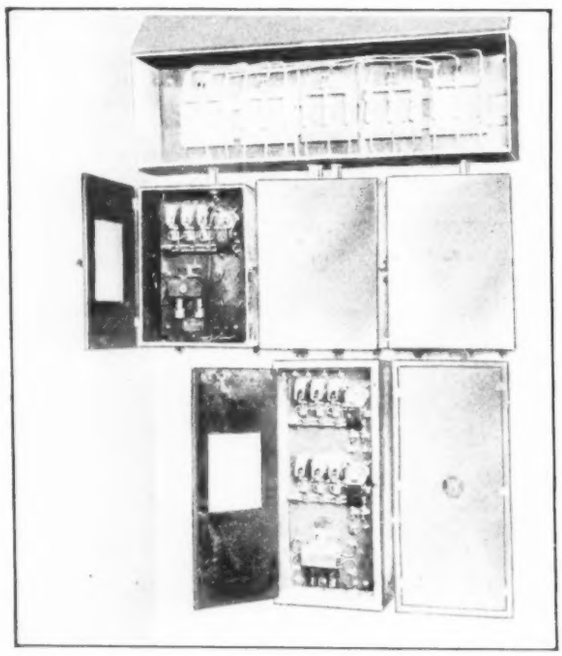


Fig. 2—Across-the-line starters mounted in space which could not otherwise be used

Disconnect switches in upper box. The starters in the lower row are arranged for reversing service with mechanical interlocks.

element overload relay is the most expensive in first cost and the most satisfactory in operation.

Magnetic starters offer many combinations of multiple starting stations in various forms for hand or automatic starting. Thus we may have a pump motor equipped with one or more push-button stations, with float control on the sump, pressure or float control on the discharge, and thermal type control on the bearings.

In the application of this type of starter certain limiting factors must be recognized. The relation between the capacity of the system and the largest motor should be such that no appreciable drop in frequency will result. The feeders should be of ample size so that the voltage drop will not be excessive in starting the largest motor

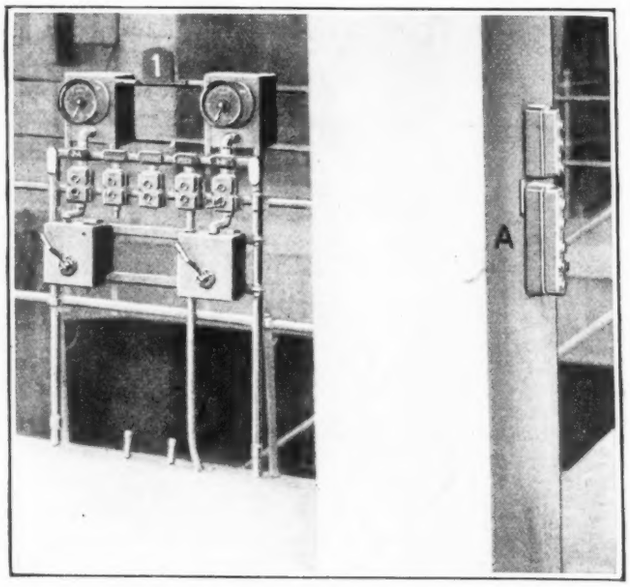


Fig. 3—Grouping of starting stations for a series of associated machines

The three-button starter on the column at *A* controls a reversing hoist with across the line starter.

with all other load on the feeder. These points become of serious importance only when large motors are to be started; with the average motor of 50 hp. or less the effect is hardly noticeable except on small systems. The motor's construction should be investigated to insure that the parts are strong enough for heavy-duty operation. High-speed motors require a longer period of acceleration and the shock is accentuated.

The effect of full-voltage starting upon the driving medium and the driven machine requires some study. The sudden start may slip a belt on a small pulley. With a chain drive the slack will be taken up suddenly with a severe impact on the driven sprocket. A combination of high-inertia parts and a slack driving chain may produce disastrous results. There are some installations, therefore, where conditions require some form of reduced voltage starter. The majority of cases, however, may be handled by the across-the-line type.

Special Types of Motors

Some forms of special motors have been developed for this type of starting. The primary of a slip-ring motor is thus thrown directly across the line. In this case the current is regulated by the secondary resistors. Large synchronous motors which have their load applied after reaching full speed are frequently thrown directly across the line. The starting winding in the pole faces of these motors is of comparatively high resistance, and this has a tendency to hold down the inrush current. An induction motor with a double-rotor winding has been developed which will start with a current peak very little in excess of the full-load current. This motor may be thrown directly across the line. These motors, however,

are all designed with special features, showing a tendency toward the elimination of the reduced-voltage starter.

The wide field of applications of the across-the-line type of starter is shown in a recent installation of some two hundred motors in a portland cement plant. Magnetic contactor type of across-the-line starters were adopted as standard for all motors of 30 hp. and less. These motors were mainly 720-r.p.m. three-phase 60-cycle 440-volt machines, although some pump and fan motors had speeds up to 1,800 r.p.m. The duty of the motors covered the various pan, belt and screw conveyors, bucket elevators, coolers, feeders, packing machines, hoists and machine-shop equipment—in general,

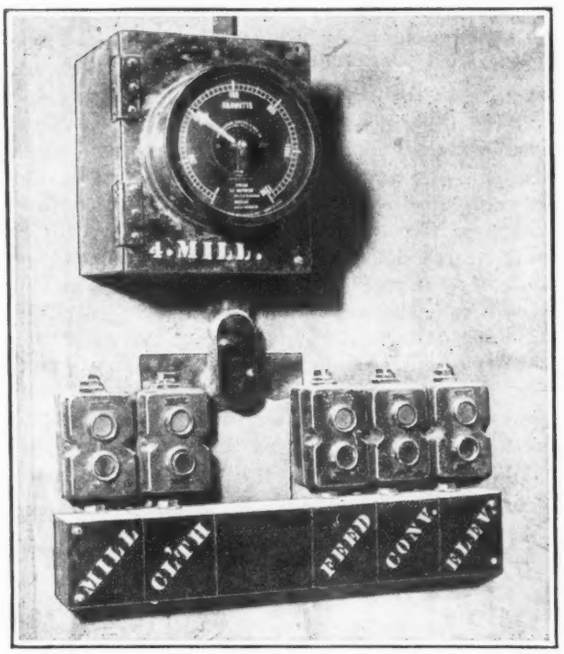


Fig. 4—Grouping of starters showing the uniformity of equipment

Three auxiliary motors are 440-volt across the line type. The mill motor is 900-hp. 2,200-volt synchronous, and the magnetic clutch is operated with 125-volt direct current.

all the auxiliary apparatus of a cement mill. Much of this must be started frequently under full load.

Two starters were used to cover the entire range. A compact type of three-pole contactor with plain contacts and overload relays was chosen for motors of 5 hp. and less. A heavier type of three-pole contactor with magnetic blowouts and overload relays was chosen for motors of 5 to 30 hp. The difference in horsepower rating was obtained by changing overload relay coils. Any maintenance engineer will appreciate the benefit of interchangeability with an installation of this character. In some cases two contactors were interlocked for reversing service on hoists and screw conveyors.

Practically all drives are direct-connected through a rubber-bushed pin-type of flexible coupling. Where speed reductions are necessary the various forms of spur- or worm-gear reducers are installed between the motors and the machine.

Installed Cost of Starters

The installed cost of the starters compared with that of the reduced-voltage type of hand starter will show a surprising saving. The added convenience in operation and the ability to bank the controls for the auxiliaries conveniently for the operators result in greater available operating time on the main grinding units and less effort on the part of the operators in starting and stopping. The clear space around the machines is appreciated in making repairs.

No direct troubles have been traced to the type of starter except in one case where the shock in starting was too great for the driving sprocket. The maintenance cost has been extremely low. In similar service this number of hand starters would require considerable attention for contact replacement with consequent loss in operating time. The elimination of the human element in manipulating the control and the addition of the magnetic blowout has practically done away with this item. In fifteen months of operation the contact replacement on this type of equipment has been less than one per cent of the contacts in service.

The low cost of the equipment, the interchangeability of the starters, the accessibility for repairs and the simplicity of the wiring allow the carrying of extra parts, quick repairs when necessary, and easy replacement of the entire starter in case of considerable damage.

Equipment in the Installation

In this installation all motors 50 hp. and larger were specified for 2,200 volts, with the smaller motors at 440 volts. It so happened that in the original designs there was no call for motors between 50 and 30 hp. Several 40-hp. motors were added later, which are operated with across-the-line starters and have given no trouble.

The 2,200-volt motors are started from 1,400-volt busbars by means of double-throw interlocked contactors. During an emergency which existed for several weeks, the 1,400-volt transformers were out of commission. The lines were cut over to furnish 2,200 volts on the starting circuit, and these motors started with full voltage. The motors in question covered induction type up to 100 hp. and synchronous up to 500 hp., on a generating system of 4,500-kw. capacity. The peaks and voltage drop did not bother the system, and no bad effects have been noted on the motors or starting equipment.

The writer's experience with this type of starting has been very satisfactory. With heavy-duty motors and adequate feeders and generating equipment the additional expenditure for reduced-voltage starters and their maintenance does not appear to be warranted except in special cases.

Less power is required to drive a centrifugal pump when the discharge valve is closed than when open, since, when partly closed, less work is performed in lifting and forcing water, and with lower velocity there is less loss of power in overcoming pipe friction. It is better practice to regulate the flow on the discharge side of the centrifugal. However, a centrifugal pump should not be operated with the discharge valve entirely closed, as the heat produced by churning the water by the impellers may so raise the temperature of the water that in a short time it becomes hot enough to vaporize and allow the pump to become steam or vapor bound, causing cutting or seizing of the bearings. A bypass should be arranged in the pipe lines, so that when it becomes necessary to operate a very low discharge capacity, the bypass can be opened and prevent this difficulty.

Psychology of Patients Determines Type of Refrigerating System

NEW YORK City group of medical buildings will install carbon-dioxide refrigerating machines. To eliminate mental disturbances of patients should a gas leak occur, an odorless refrigerant was deemed desirable. Corliss engines are to be direct connected to the compressors.

THE Columbia Presbyterian Medical Center is erecting a group of buildings at One Hundred Sixty-eighth Street and Broadway, New York City, consisting of a power house, a hospital building, a medical college, a private patients' pavilion, nurses' home, etc. The refrigeration load consists of water cooling, ice making and the cooling of refrigerators.

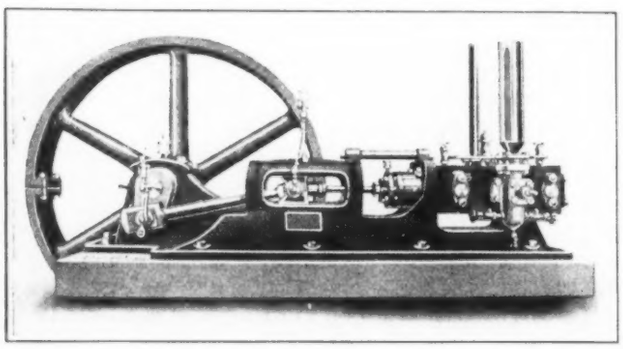


Fig. 1—Type of CO_2 compressor to be installed

There are a total of 112 refrigerators having a storage capacity of approximately 30,000 cu.ft., cooled by a total of approximately 15,000 lin.ft. of 1¼-in. brine pipe made into continuous electric-welded coils, galvanized on the outside. The ice-making capacity is ten tons of ice daily and the water-cooling capacity is equal to ten tons of refrigeration.

Choice of Refrigerant

Early in the study it was necessary to decide as to the refrigerant to be used, the choice being between ammonia and carbon dioxide. For the conditions obtaining in New York City, the amounts of condensing water required by the two systems are equal, the power required per ton of refrigeration is, for practical purposes, identical and the costs of the two systems are the same. The medical authorities felt that the patients' reactions to possible ammonia leaks would be psychologically unfavorable, and so it was concluded that the odorless and harmless carbon dioxide was to be preferred as the refrigerant.

To meet the municipal requirements covering refrigerating installations, the machine room was placed to one side of the main building ground plan with a wall between.

The capacity of the plant was determined by a study of the requirements of other hospitals and medical colleges, and two 5½x20-in. double-acting CO_2 compressors, such as shown in Fig. 1, seemed to be the most advisable sizes, these having a rating of 50 tons of refrigeration at 100 r.p.m. and at a suction temperature of 0 deg. F. and a condenser pressure corresponding to the average New York City water temperature of 69 deg. F.

Compressors Are Steam-Driven

Although all the other power and the lighting energy used in the buildings will be purchased, the CO_2 compressors will be direct-connected to steam engines. Under usual circumstances this plan of using steam-driven compressors while purchasing other power requirements might appear illogical. The Medical Center will have a large demand for steam for sterilizing, cooking and other purposes during the entire year and of course will consume much more during the six or seven colder months for heating purposes. For most, if not all, of these requirements low-pressure steam would be suitable, and as the steam consumption of the compressor engines will practically meet the demand save for the heating system, it was the economical solution to install high-pressure boilers and, by first passing the heating-system steam through the engines, obtain the compressor power at a cost much below that of purchased energy.

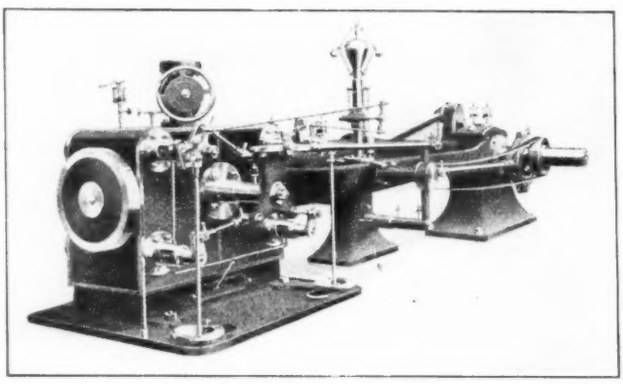


Fig. 2—Murray Corliss engines have girdle frames

There is, in addition, but a slight difference in the cost installed of high-pressure boilers compared to the cost of low-pressure units. The presence of the high-pressure boilers will permit the management to install a generating plant at a low cost in case electrical rates should ever unduly increase.

Since the compressor speed is limited by reason of the comparatively long stroke of 20 in., high-speed uniflow engines could not be used. The engineers felt that the uniflow engine shows its best performance at a high speed and when the rate is brought down to 100 r.p.m. an engine of this type has a steam consumption but little better than that of a well-designed Corliss. In addition the uniflow when rated at, say, 100 r.p.m. has a high

initial cost per horsepower capacity that does not justify its use in cases where during the heating season the demand is greater than the amount of steam exhausted by the engine.

In consequence of this reasoning two 12x30-in. single-cylinder Murray Corliss engines of the type illustrated in Fig. 2, are to be used to drive the compressors. The compressor shafts will be turned to fit the engines' main bearings and to receive their cranks.

Both the engines and the compressors were designed to be so closely balanced that vibrations would not set up in the floor and building members. It will be seen from Fig. 4 that the machinery will rest upon the 6-in. concrete floor slab, therefore lightness of weight was desirable in the effort to reduce the load per square foot of floor surface. This led to the specifying of girder frames for the Corliss engines in preference to the heavier rolling-mill design. Each of the compressors will weigh 10,000 lb., the flywheel 10,000 and the engines 11,000 lb., giving a total weight per unit of 15½ tons.

Steam for these engines will be supplied from the boilers located in an adjoining space of the same building placed at a lower level. The initial pressure is to be 150 lb., and the engine will exhaust at 5 lb. gage into the heating system.

The condensers, Fig. 5, will be of the double-pipe type; there will be 9 stands of coils, each containing 8 coils of 2½- and 1¼-in. pipe 20 ft. long and 8 coils of 2- and 1¼-in. pipe of the same length. These will operate on the counterflow principle, with the gas entering at the top and the liquid CO_2 leaving at the bottom. The water or inner pipes are in series multiple, entrance being at the bottom and middle coils. This permits considerable subcooling of the liquid. The use of both 2- and 2½-in. pipe in the same condenser stand is not unusual; it is advisable since the large annular space between the 2½- and the 1¼-in. pipe accommodates the gas volume more readily without an excessive pressure drop.

The brine cooler will be of the double-pipe type, a shell-and-tube cooler being impractical with the pressures existing within the CO_2 system, particularly for an installation of this size. There are to be eight stands of brine cooler, each stand 17½ ft. long and 18 pipes high, made of 2- and 1¼-in. pipe. Each stand will take one expansion valve, but the brine will enter at three places, making each stand divided into three 6-pipe-high sections. It is expected that the brine exit temperature will average about 10 deg. F.

The brine coolers will be set in an insulated cooler house, this insulation consisting of sheet cork with a portland cement finish; this cooler house will be provided with a number of standard cold-storage doors, these being used for entrance into the cooler house and for the removal of any of the brine-cooler sections when needed.

The cold brine will be pumped by one of two 12x8½x12

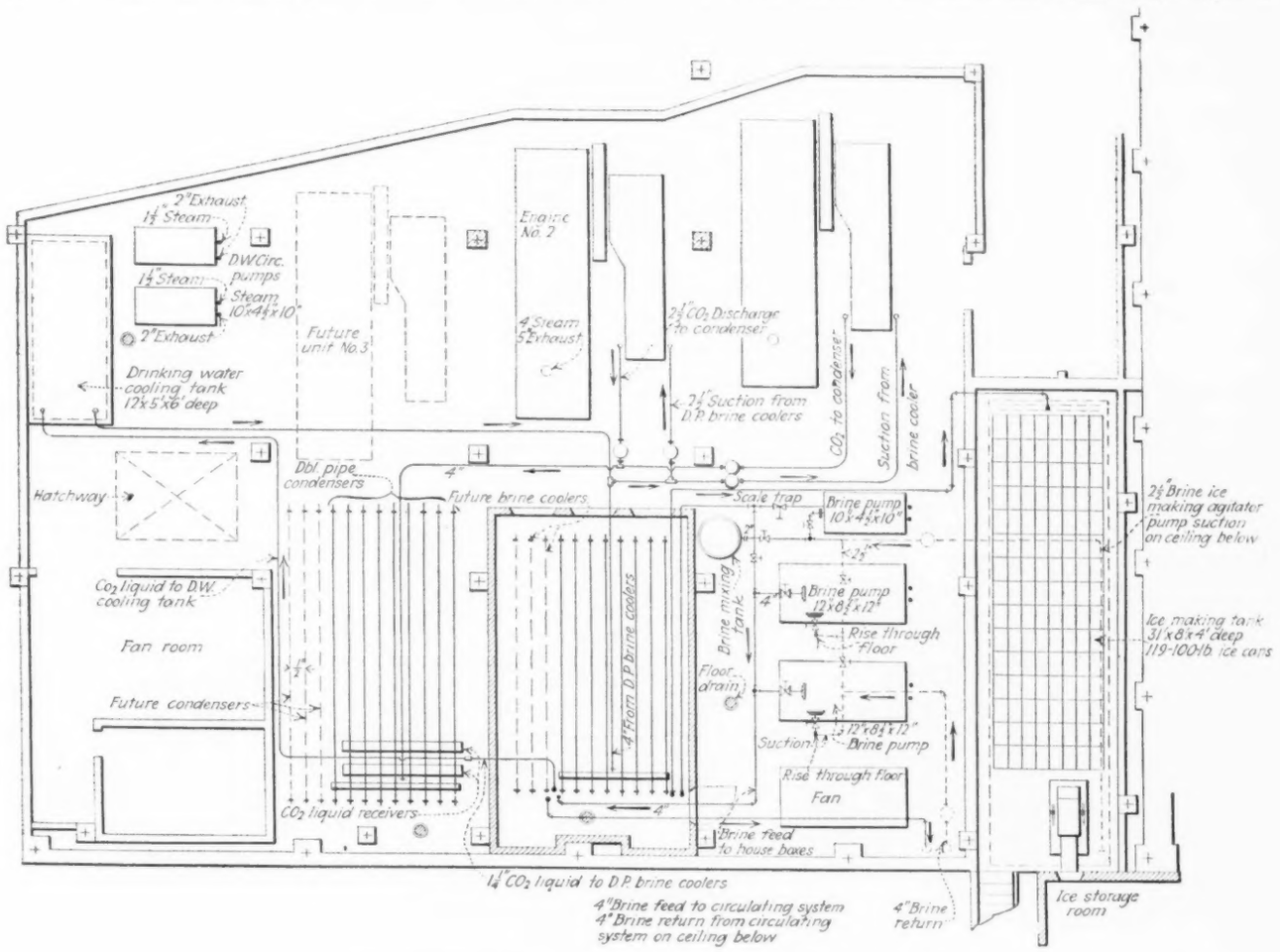


Fig. 3—Plan of the machine room with the equipment

Worthington piston-packed duplex steam pumps, one of the pumps being a spare. The brine will leave the ice-machine room through 4-in. brine mains and will then be distributed through the various buildings by means of six main risers and branches from these, the risers

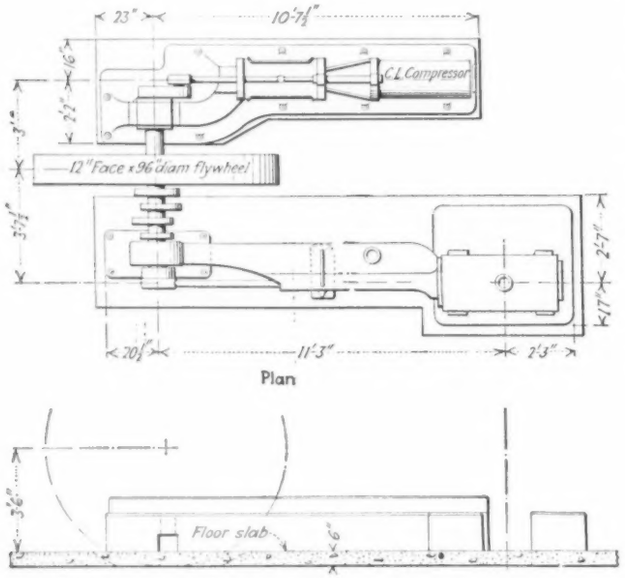


Fig. 4—Lack of foundation necessitates close balancing of the units

being all interconnected at the highest point with an open-type balancing tank, thus giving excellent air venting and good brine balance for circulation.

All the brine piping and all other CO_2 piping subject to frosting will be covered with Nonpareil sectional molded cork standard brine thickness covering. The total lineal feet of line pipe covered, which includes all

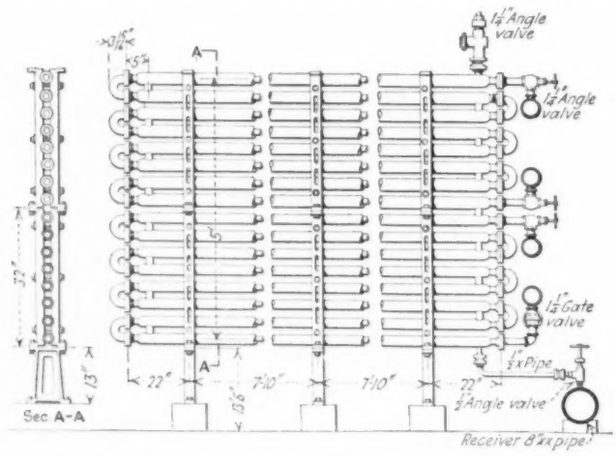


Fig. 5—Condensers are double-pipe with coils in parallel series

mains, branches and risers, would approximate 11,000 lin.ft. of the various sized pipe.

To handle the cooled drinking water, there will be two 10x4½x10 duplex Snow-pattern Worthington steam-driven pumps, while a third of the same size and type will be used to circulate brine from the brine cooler to the ice freezing tank.

Steam rather than electrically driven centrifugal pumps were adopted for two reasons. In the first place during a greater part of the time the low-pressure steam demand will exceed the amount rejected by the Corliss engines and the pumping cost will be low if the exhaust is turned into the low-pressure mains. A second argument for the steam-driven pump is that it lends itself to greater flexibility in operation, particularly where total pumping head variations are likely to occur and where the exact friction and static heads cannot be ascertained before installation.

In the ice tank will be placed 119 100-lb. cans. The steel tank is 31x8x4 ft. and is to be insulated with granulated cork and cork blocks. A hand hoist and traveling crane will be provided for lifting the ice cans, as well as an automatic ice dump for thawing the ice out of the cans.

Originally, it was the intention to install machinery to supply the ice-cream demands of the hospital. The making of the ice cream would call for an attendant, and the estimated consumption of 100 gal. per day was too small to justify the labor, consequently the cream will be purchased outside.

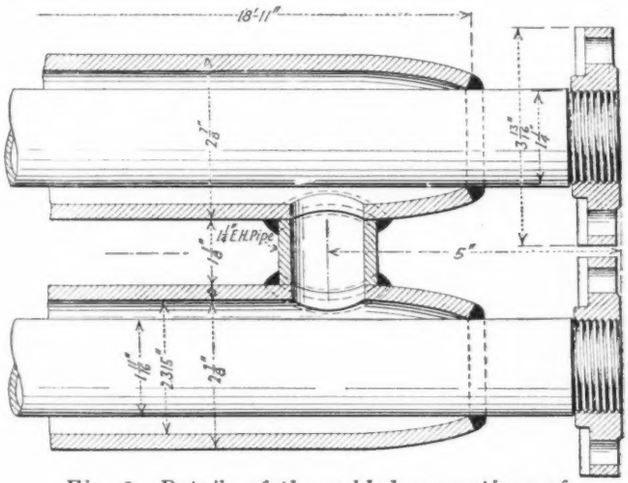


Fig. 6—Details of the welded connections of the condenser

Water for the CO_2 condenser will be taken from the city mains and, instead of being recooled in a tower or spray pond, will be put into the building warm service mains. The water will be heated by the engine exhaust or by live steam if necessary.

The water expense chargeable to the refrigerating plant is the pumping cost. This will substantially reduce the cost of operation of the refrigerating plant. In addition the refrigerating plant should be credited with the heat given up to the service water.

One of the features on this installation is the welded construction instead of flanges or other form of connection. The various sections of the condensers and brine coolers are of the welded type; all the CO_2 lines and interconnections between the compressors, condensers and brine coolers will be welded instead of made up with flanges or other form of connection. The only place where flanges will be used will be where sections of the apparatus have to have provision for removal. The foregoing welded construction applies only to the CO_2 circuit; the brine circuit is made up in the usual manner.

The consulting engineer responsible for the plant design is Werner Nygren, while the Brunswick-Kroeschall Co. will supply and install all the equipment.

Details of Hudson Avenue

80,000-Kilowatt Turbine Unit

Its General Design Features. Cylinder Construction. Nozzles and Blading. Low-Pressure Exhaust Design to Reduce Losses. A Second Article Will Describe the Governor Gear and Other Details

THE latest addition to the Hudson Avenue Station of the Brooklyn Edison Company, a unit of 80,000-kw. in two cylinders, was placed in operation on Sept. 1, 1926. This unit is of more than ordinary interest, not alone because of its size, although it is the largest generating unit in operation today, but also because its construction embodies a number of unique features designed to solve the peculiar problems attendant upon the increasing physical dimensions and the ever higher steam conditions of current practice.

This unit is a cross-compound turbine of the combination impulse and reaction type. Each turbine drives a generator of 44,450-kva. rating, 40,000-kw. at 90 per cent power factor, producing three-phase 60-cycle current at a potential of 13,800 volts. The high-pressure turbine generator is fitted with a 300-kw. direct-connected exciter. Both turbines are designed to run at 1,800-r.p.m. and are adapted for heating their own feed by steam extracted from four stages of the combined unit.

Steam is supplied at 375 lb. per sq.in. gage, at 700 deg. F., and the turbine is designed for an exhaust pressure of 1.0 in. of mercury absolute. The turbines are designed to carry the maximum generator capacity of 88,900-kva. with unity power factor when heating feed in four stages.

Steam from the throttle valve passes through the inlet pipe to the nozzle chambers of the high-pressure turbine, expands in the nozzles and passes through a two-row impulse element into the high-pressure reaction group of 13 pairs of rows of blades. From the exhaust of the high-pressure element the steam is led through a receiver pipe to the low-pressure turbine, a double-flow machine with two groups of 9 pairs of rows each, through which the steam expands toward the ends of the turbine, whence it passes to the surface condenser.

The handling of the quantity of steam required for the designed capacity in the high-pressure zones presents no difficulties. However, the proper proportioning of the low-pressure end for efficient energy extraction, without exceeding safe limits in the structural design, constitutes a difficult problem. The high standards of efficiency now demanded by central-station engineers, together with the beneficial effect of commercial competition, have led to the adoption of a speed of 1,800 r.p.m. for large central-station turbines in 60-cycle service. The cost for turbine parts per kilo-

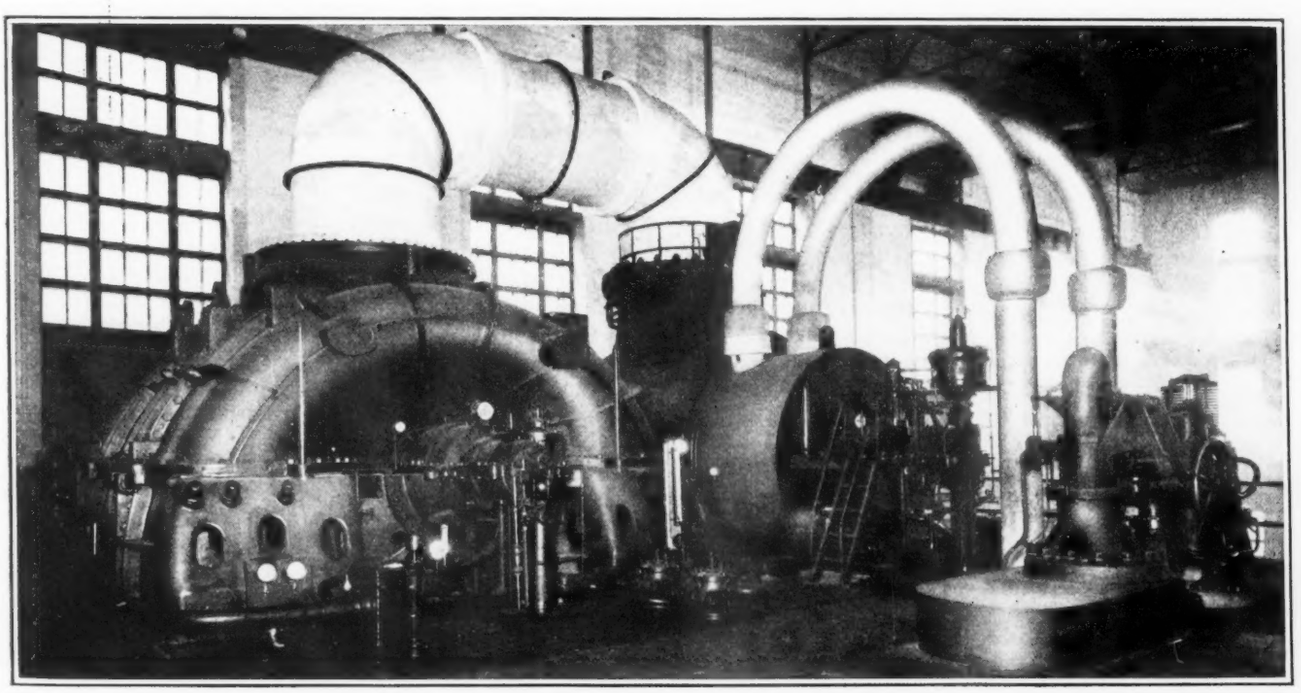


Fig. 1—The largest turbine unit now operating

The over-all length of the unit is 67 ft. 6 in., the width, 36 ft., and the height from the floor to the top of the receiver pipe, 24 ft. 5 in.

watt of rating increases approximately in the inverse ratio of the rotative speed. The windage losses are reduced with the higher rotative speeds.

Having decided upon a rotative speed of 1,800 r.p.m., the need of a compound turbine for a capacity such as that of the unit under consideration becomes apparent because of structural limitations. It might appear at first that the increase in cost of construction that follows the change from the single- to the two-cylinder arrangement might offset the advantages of the high rotative speed and thus force the adoption of 1,200-r.p.m. single-cylinder design. There are other advantages of the 1,800-r.p.m. turbine construction, however, that enter into the problem and offset the increased cost of the two-cylinder machine. For instance, the higher-speed rotors are of such size that they can be completely finished, seasoned and balanced in the manufacturer's works and shipped to the station without disturbing the spindle assembly in any way. The operating characteristics of the smaller turbine spindles are much better than would be secured with a large, single rotor. The smaller rotors can be started much more quickly in case of emergency. The compound arrangement permits greater latitude in the selection of blading dimensions and spindle diameters than is possible in the single-cylinder machine, since the same limitations of spindle construction are not encountered when the spindle is divided into two parts. The blade and gland clearances are much more easily controlled in the compound design, resulting in an improved over-all efficiency. Hence, if the general survey is extended to the construction and operation of the machine, the two-cylinder construction is easily justified.

The design of generators for such large capacities involves questions equally difficult of solution. It was found expedient to divide the total load between two generators. Consequently, the high-pressure and low-pressure turbines were placed side by side, each driving its own generator and forming a cross-compound unit rather than a tandem unit with a single generator.

A further important advantage of the cross-compound arrangement is the mechanical separation of the high-pressure and low-pressure spindles, preventing the transmission of mechanical disturbance from one spindle to the other.

The use of the double-flow arrangement of low-pressure blading follows directly from the structural limitations, as influenced by the problems of cost and shipping facilities.

The section of the high-pressure turbine shown in Fig. 2 shows that the principal duty of the cylinder is to serve as an envelope to hold together the several elements. The actual duty of supporting the stationary blading and directing the flow of steam is carried out by the nozzle chambers and two blade rings, made in halves, bolted together, and secured to the outer cylinder.

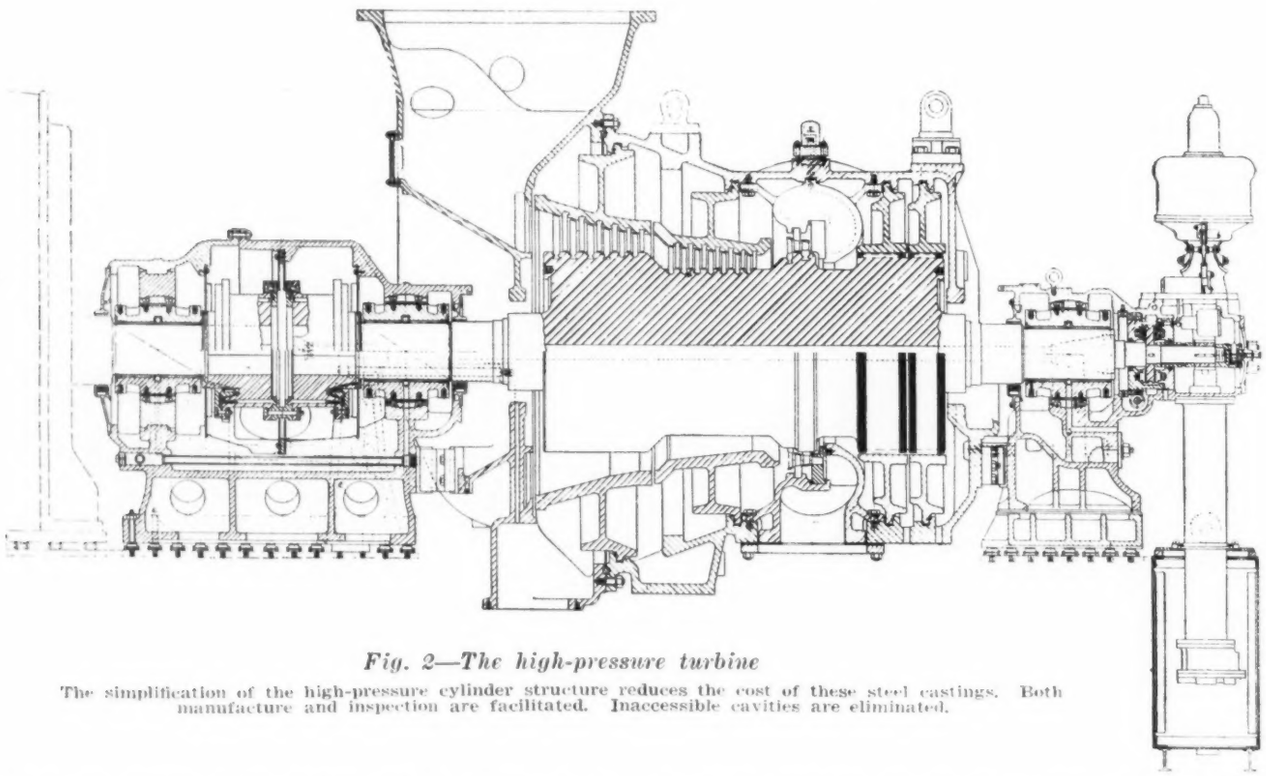


Fig. 2—The high-pressure turbine

The simplification of the high-pressure cylinder structure reduces the cost of these steel castings. Both manufacture and inspection are facilitated. Inaccessible cavities are eliminated.

With the blade ring construction the blading is held in relatively small elements that can be worked on simultaneously with a resultant lower cost of production than is possible when the blade grooves are cut in the main cylinder wall. The blade rings are made with an I-beam cross-section, so that, in the event of an accidental blade rub there is little or no danger of permanent distortion.

In many cases foundry difficulties would be encountered if an attempt were made to construct the cylinders with the annular bleeder steam passages cast integral with the main parts. An annular passage is desirable, in order that the steam may be tapped uniformly from the active steam path, as otherwise cross-flow will result, with loss of efficiency. In the zones below the dewpoint the annular opening leading from the main steam path is reduced to secure a steam velocity of approximately 150 ft. per sec., for the purpose of forcing the maximum amount of moisture to

flow from the outer periphery of the main steam path into the feed heaters.

The blade rings and similar rings supporting the dummy strips are so supported that they may expand at a more rapid rate than the main cylinder wall. Such provision is necessary, as with variation of load the inner bore of the ring that carries the blades changes temperature much more rapidly than the cylinder wall, thus giving rise to some differential expansion between the blade ring and the main cylinder.

There are three nozzle chambers, a primary nozzle chamber in the cylinder base, and secondary and tertiary chambers located in the cover. As shown in the upper part of Fig. 2, circular keys, extending around part of the outer circumference of the nozzle chambers, engage a corresponding groove in the turbine cylinder to maintain the nozzle chambers in their correct axial location. Massive cylindrical ribs, extending to either side of the nozzle chamber to maintain the correct radial position, are held against the bored cylinder faces by radial bolts located on either side of each steam inlet. These bolts are sufficiently long so that the stresses caused by the circumferential expansion are quite low. The bolts are located in the same plane as the circular keys. One of the radial support bolts is shown in the upper part of Fig. 2, in dotted lines. Numerous shoulder bolts are fitted through the cylindrical ribs with small clearances under the heads to permit free expansion of the nozzle chambers, while at the same time additional strength is available in case of accidental rubbing. The inlet openings to the nozzle chambers are short flanged nozzles with the machined faces in the same plane as corresponding flanged faces on the outer cylinder wall. A thin metal seal-plate is bolted to the main cylinder structure and to the nozzle chamber to seal against steam leakage from the impulse chamber and at the same time to allow free expansion of the nozzle chambers. The inlet pipe flange serves as a holding clamp for the flexible seal plate on the nozzle-chamber inlet flange

The high-pressure turbine exhaust chamber has been carefully laid out to preserve the residual energy of the steam leaving the last row of moving blades, so that a very low pressure drop will be required to carry the steam into the receiver pipe.

The cylinder structure in the case of the low-pressure turbine is greatly complicated by the size of the inlet and exhaust openings. For satisfactory operation it is essential that this cylinder have even greater structural rigidity than that of the high-pressure turbine; yet it is equally essential that sufficient area be provided for the inlet and main exhaust openings. It will be noted that the exhaust opening occupies the whole bottom half of the cylinder. Owing to the average temperature difference between the blade ring and the outer cylinder a special method of support is required to take care of the differential expansion to avoid overstressing or distortion of the cylinder parts.

One of the most serious problems in the design of this exhaust casing is the bracing to withstand atmospheric pressure. The longitudinal bracing in the base is secured by a series of vertical ribs co-operating to form a series of continuous struts from one end wall of the cylinder to the other. The main blade ring structure is designed to add further to the longitudinal bracing against the atmospheric collapsing load, and additional stiffening is secured by the deep vertical flanges

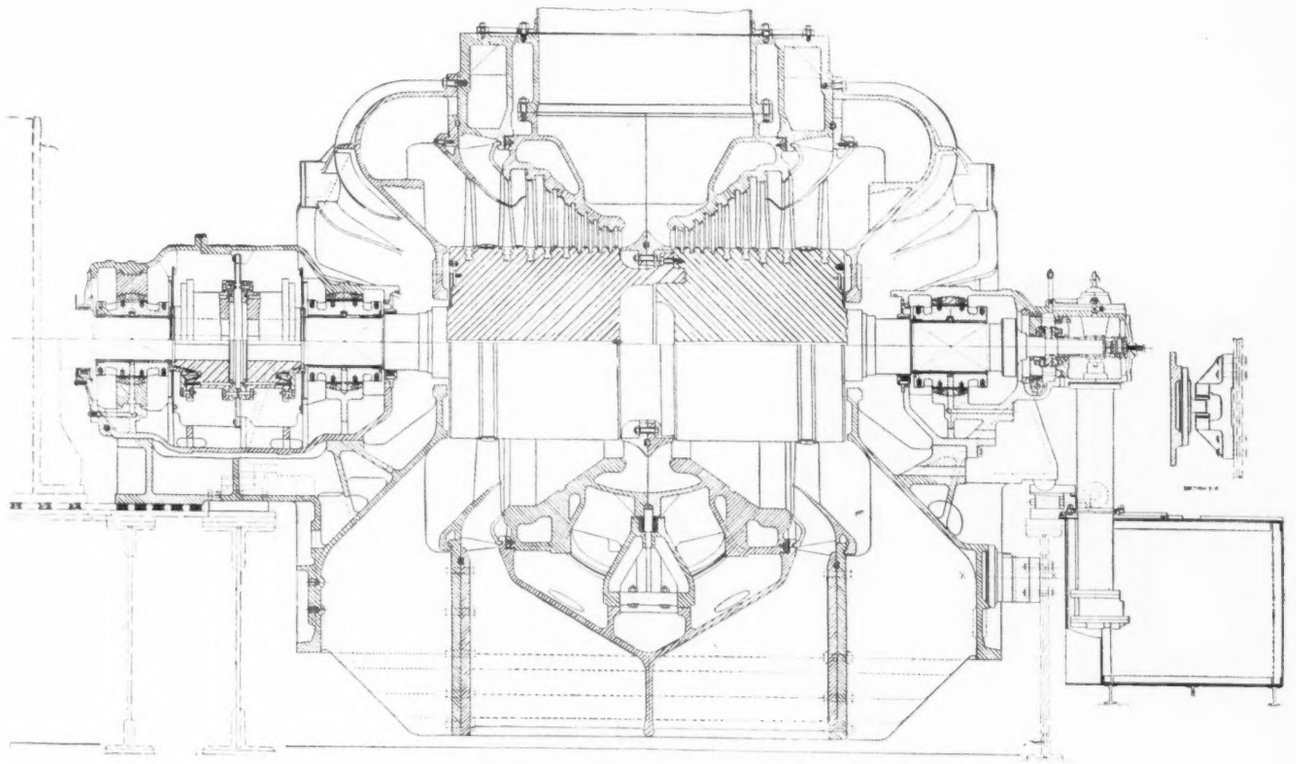


Fig. 3—The low-pressure turbine

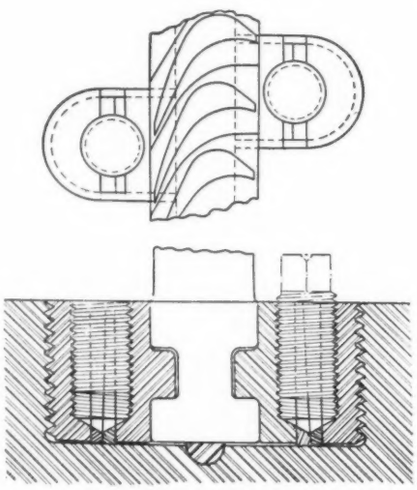
The low-pressure casing is in two parts, a massive outer cylinder that forms the exhaust casing, and an inner blade ring arranged to form the steam inlet passage. The outer cylinder is made in six pieces, with two vertical joints, the inner ring in four pieces. Cast iron is used throughout, since the temperatures and stresses are low.

that join the respective parts of the outer cylinder. The bending stress of the cylinder is reduced by a system of diagonal steel tension members fitted in the exhaust passages.

In the case of the low-pressure cylinder it is also necessary that proper guides be provided for the exhaust steam going to the condenser, in order to prevent concentration of the steam flow in a comparatively small part of the exhaust area. This is accomplished by suitable design of the longitudinal ribs previously referred to, which thus serve a double purpose.

A recent change to secure higher efficiency has been the introduction of conical cylinder bores to eliminate the eddy spaces left by the older type of stepped cylindrical barrel construction.

The multiple exhaust principle is employed, with two outlets to the condenser at each end of the low-pressure turbine. The longest blade is 23½ in. and the drum diameter 63 in. This gives an annular area of 44.3 sq.ft. for the row of longest low-pressure blades, and, by the double-flow arrangement the total annular area is 88.6 sq.ft. By the use of the multiple-exhaust principle this total annular area is further increased to a total of 128.3 sq.ft. The multiple-exhaust principle is particularly adapted to turbines having relatively long blades in the low-pressure end, as the last group of low-pressure blades is really divided into two annular portions, the outer portion having higher blade velocity and requiring fewer rows of blades than the inner portion. All blades in the multiple-exhaust portion are designed with warped inlet edges, so that the steam is carried through the respective rows with no greater eddy loss than in standard reaction blading.



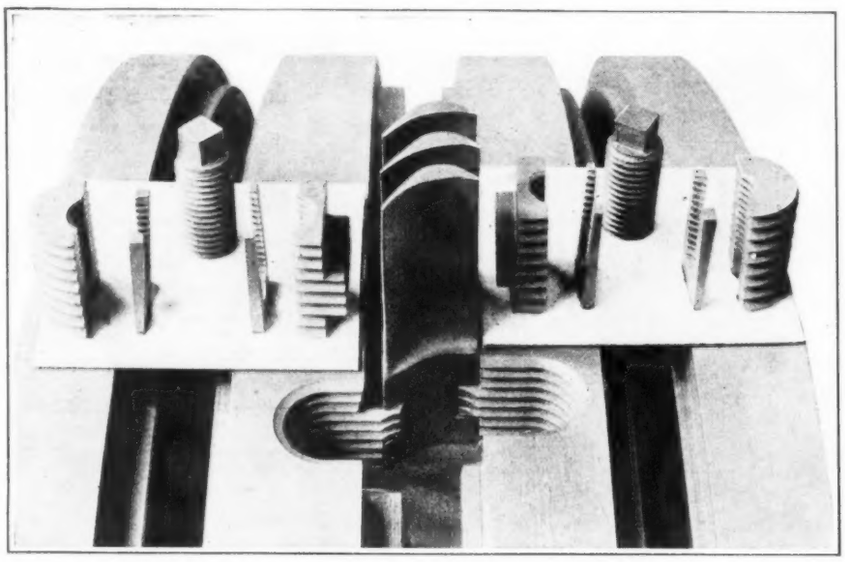


Fig. 4—A locking device to permit the last blades being entered in the rotor slots

Formerly, it was common to omit the last blades in each row, as no locking device of sufficient strength and reliability was available

In the low-pressure turbine, a blade ring is arranged to carry the double-flow blading, both groups being identical in size and number of stages, but of opposite hand. Each last row of guide blades in the blade ring is divided into two portions by an annular partition which separates the stream of steam into two parts. This is part of the multiple-exhaust arrangement. The blade ring is carried at its outer edge in grooves turned in the cylinder. The central portion of the blade ring rests in a saddle carried by the cylinder base.

The main body of the high-pressure turbine rotor is a single solid forging of annealed carbon steel. At the governor end a separate stub-shaft is attached by means of a taper fit and threaded nut. This is a comparatively small diameter piece which carries the thrust bearing, governor worm and automatic stop governor. The solid spindle construction was adopted because the forgings in question were not too large to be within the range of present-day good forging practice.

A central 4-in. inspection hole was drilled from end to end of the rotor. This hole is bored with a gun-barrel bit in order to secure a high finish without the burnishing effect of reaming. A thorough examination of the interior of the forging was made by means of a specially constructed telescope and combination of prisms. The manufacturer's previous experience gained by painstaking study of sections of forgings of large size has shown that such internal examination gives thoroughly dependable information about the character of the forging.

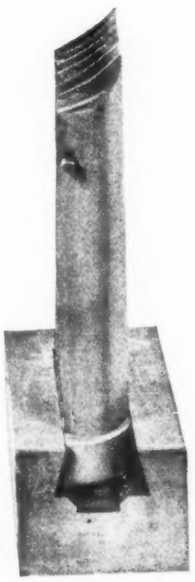
In the case of the low-pressure rotor, the overall dimensions were beyond the limit of capacity of the steel manufacturers, so this rotor is made of two forgings, bolted together. The design of the bolting is such that there is sufficient bolt power in the joints to hold the parts together by friction alone. These bolts have their centers drilled with stepped measuring holes, and when the bolts were put in place, they were accurately loaded to a predetermined stress, gaged by micrometer measurements at the bolt stretch. In this manner uniformity of both loading and stress is assured.

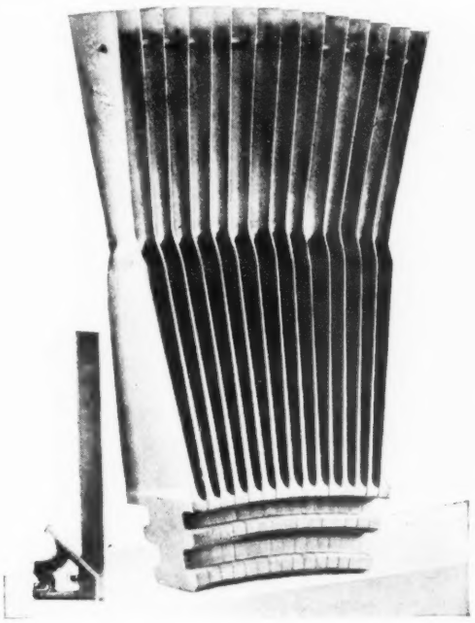
The inlet chamber in the low-pressure blade ring is made of gradually decreasing cross-section, with several guiding ribs designed to reduce disturbances to steam flow, and thereby eliminate eddy currents and minimize the pressure drop required to carry the steam to the inlet side of the two first rows of stationary blades. This obviously increases the efficiency of the unit.

Nozzle and Blading Details

Manganese-copper blading is used for spindle and cylinder blades where stress and temperature permit. Where necessary, 5 per cent electric-furnace nickel steel is used, with a carbon content not over 0.10 per cent

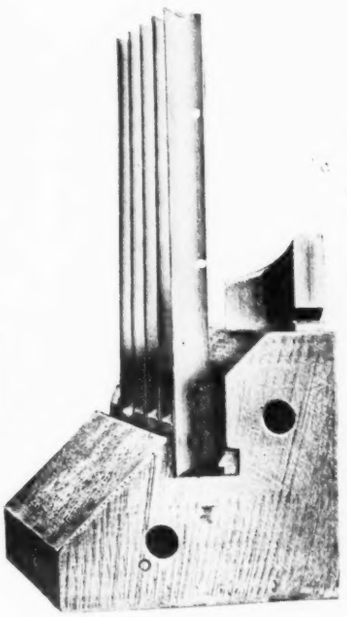
a. Spindle blades are held in dovetail slots





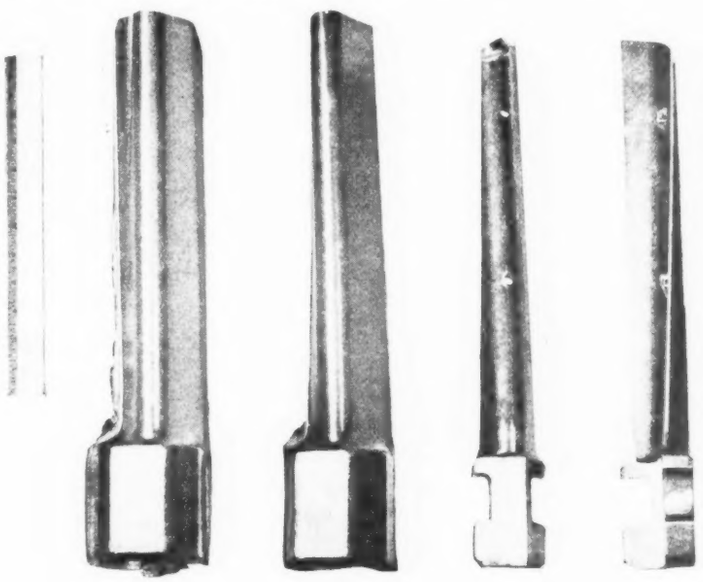
c. A group of low-pressure blades assembled for inspection shows the double-tongued root required for adequate strength

b. The use of drawn blading in conical bores requires a modified fastening



d. Low-pressure blading is tapered to secure increased steam area without a corresponding increase in stress. Tapered blades are drop forged and machined

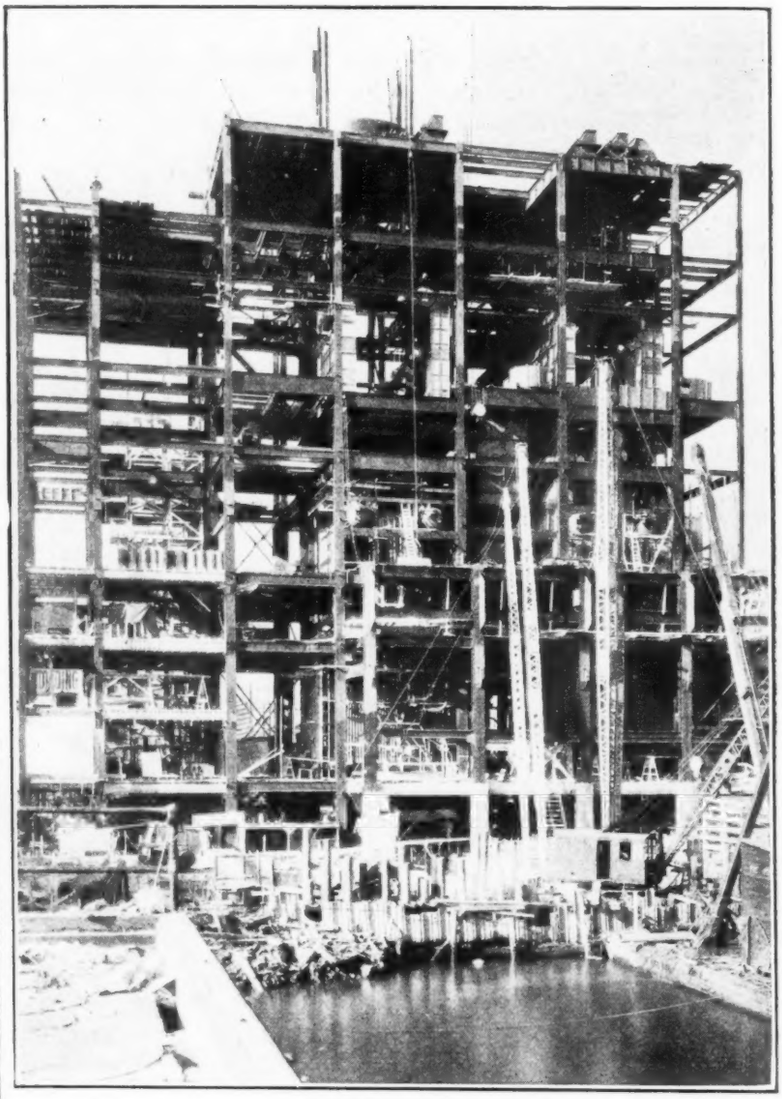
A problem in connection with the low-pressure blades arises from the variation in velocity from the tip to the base of the blade. The steam leaves the preceding row of stationary blades at a constant velocity and angle along the outlet edge. The inlet edges of the long blades in the low-pressure end are warped, as shown in the right-hand view below.



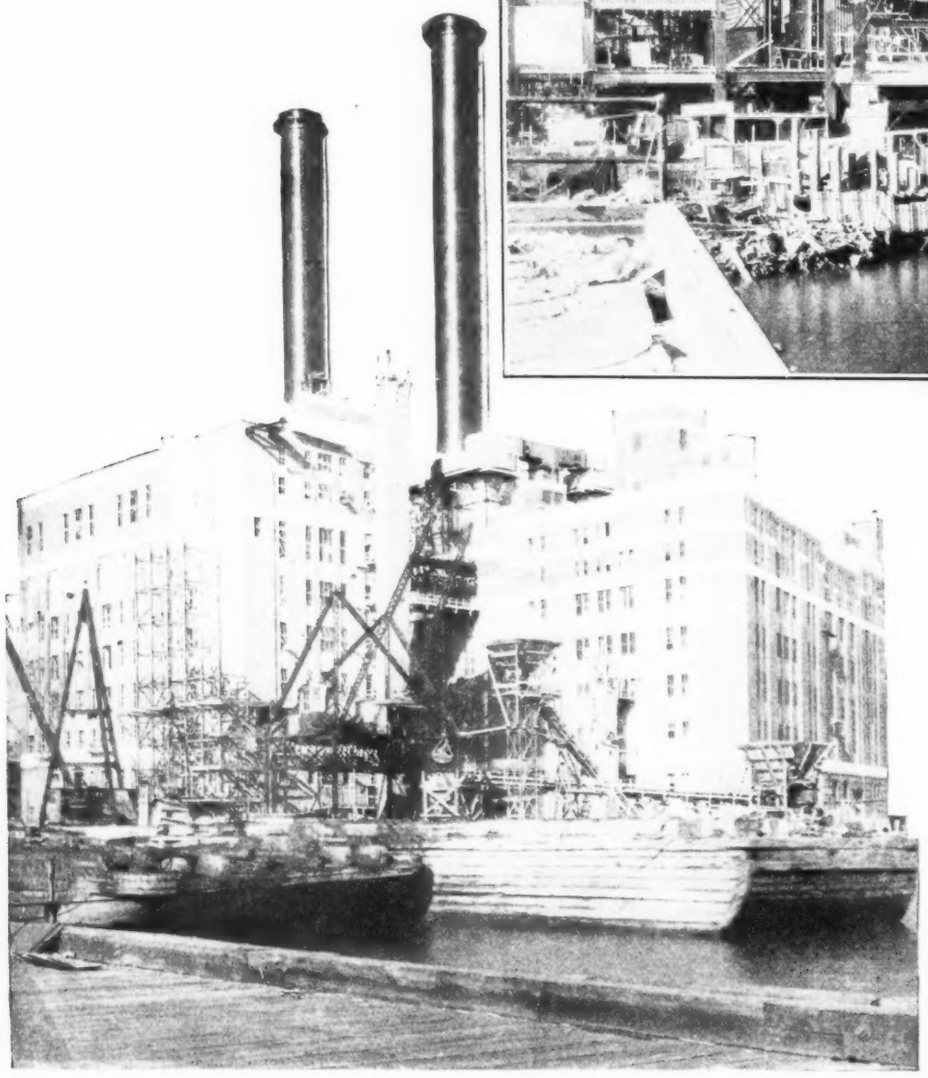
e. An all-steel nozzle construction is used, in which the nozzle ports are cut on the inner and outer surfaces of forged steel rings. Pressed nickel-steel plates are then fitted and welded in milled grooves to form the partitions between adjacent passages.

Huge Plants Rise in Crowded Manhattan

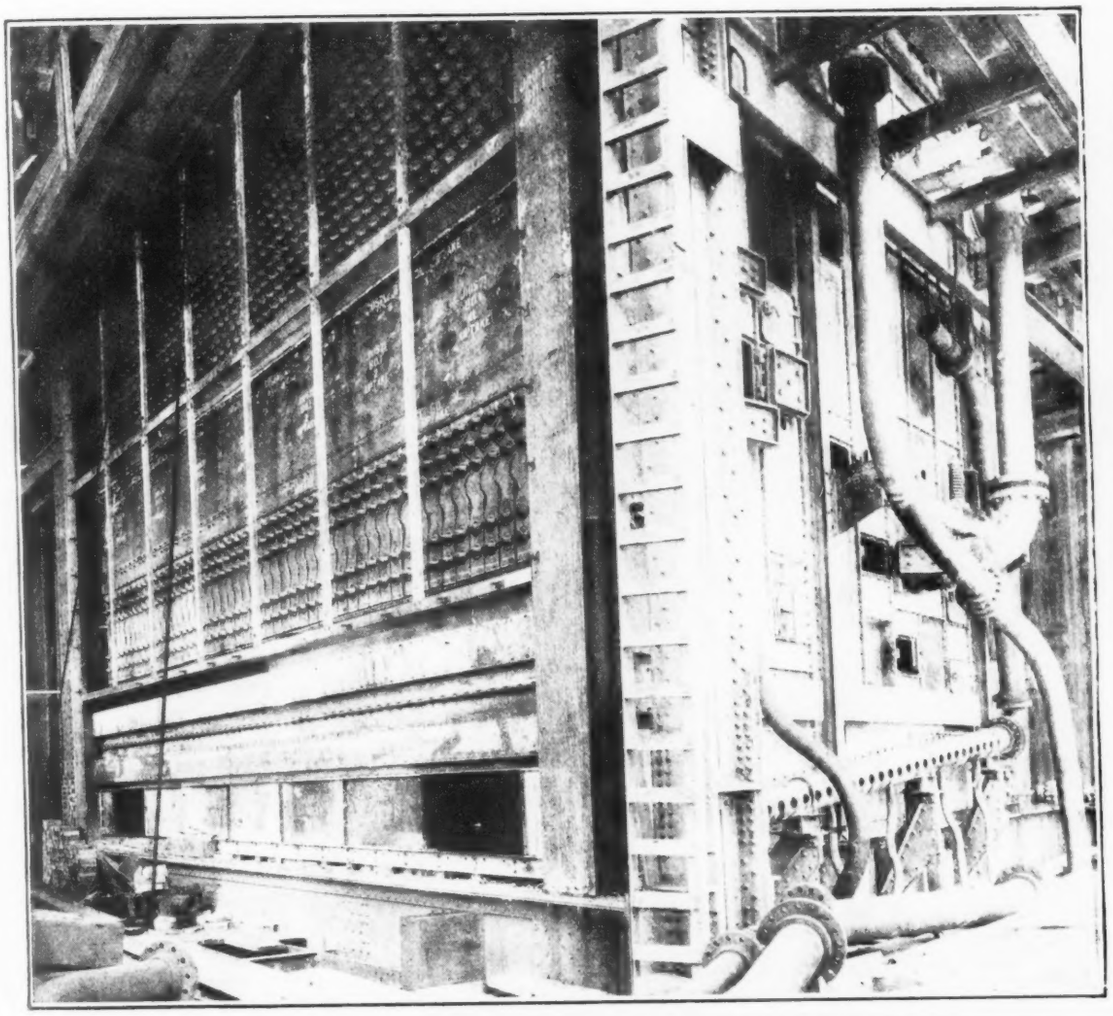
To Meet the Growing Demand for Heating Steam and Electric Power on Manhattan Island, the Heart of New York City, Two Great Plants Are Under Construction on the East River Shore



Below—Queen Marie of Roumania, as the last official act of her American trip, started the first unit of the new East River station of the New York Edison Company at Fourteenth Street, last Tuesday, Nov. 23. Pulverized fuel with full automatic control is used. The projected ultimate capacity of the station is about 750,000 kw.

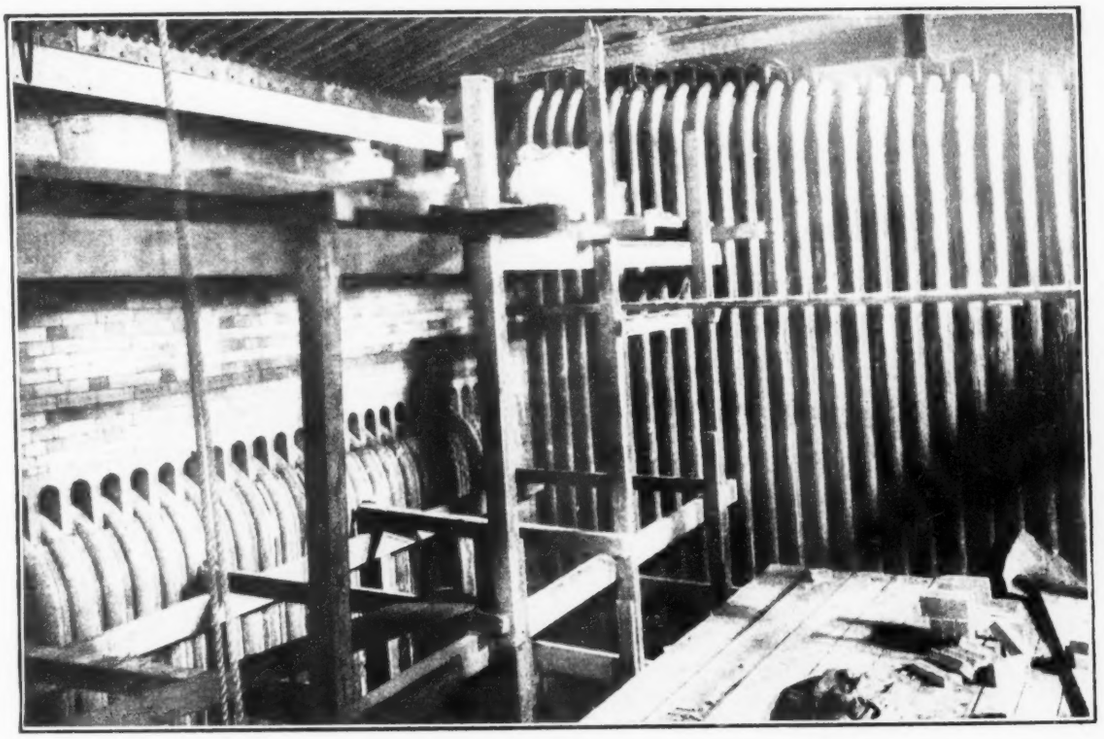


Above—Additional heat for midtown business and residential sections will be furnished by the large boilers now visible through the steel framework of the new Kips Bay station of the New York Steam Company. It stands at Thirty-Fifth Street and East River, alongside the Waterside stations of the New York Edison Company. When completed, the Kips Bay station will be the largest in the world devoted to the production of steam for general distribution to domestic and industrial users



Extending vertically through several stories, the large central-station boiler of today can rarely be photographed as a whole

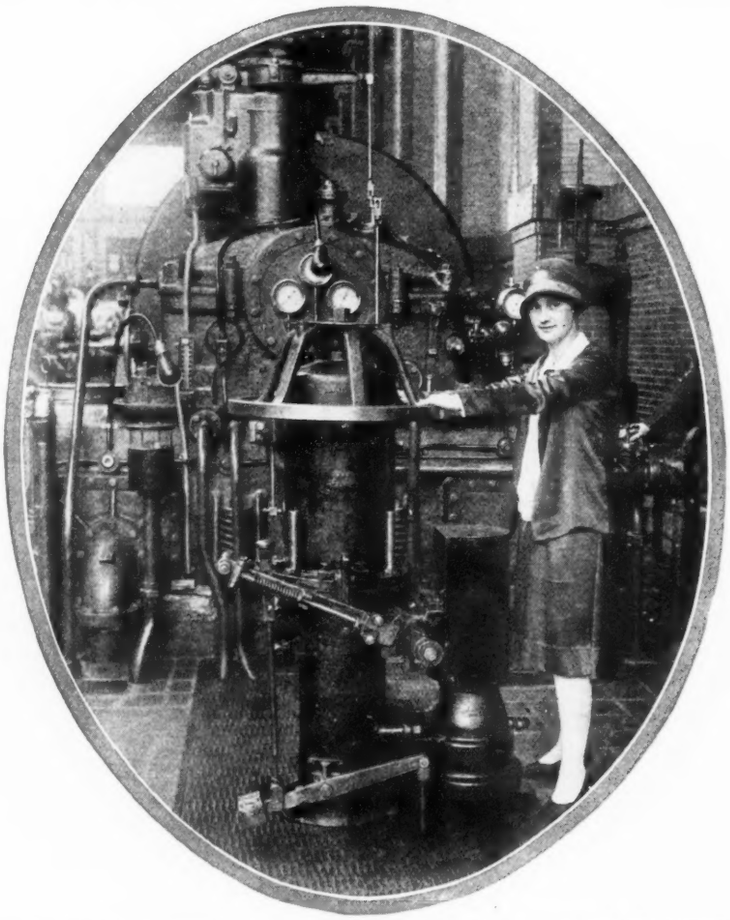
The pictures show the outside of such a boiler at the tube level and the top of the furnace interior on the story below. These photographs were taken recently in the Gould Street station now nearing completion in Baltimore. The furnace is fired with pulverized coal and lined with finned water tubes. Another view of this furnace was shown on page 625 of the Oct. 26 issue



Girl M.E. Student Starts 1,300-Lb. Turbine

Miss Miriam Anderson, engineering student and daughter of an engineer, turned the throttle admitting 1,300-lb. steam to the new 7,000-kw. high-pressure turbine when the unit was started at Lakeside Plant (Milwaukee) on Nov. 6

Miss Anderson's father is John Anderson, vice-pres., Milwaukee Electric Railway & Light Co.

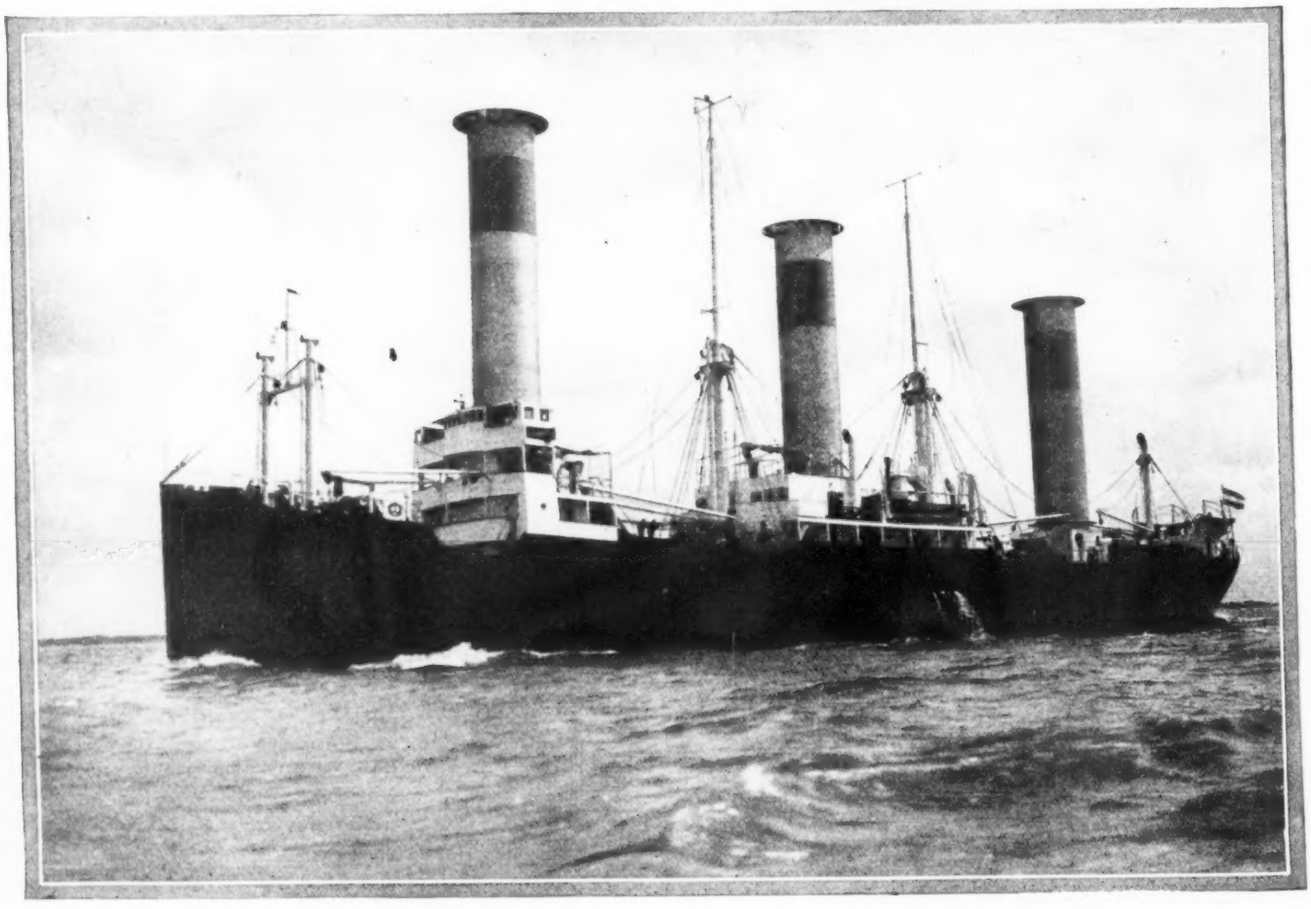


Three Thousand Ton Rotorship

Below—Recent photo of 3,000-ton (dead weight) rotorship "Barbara"

This second Flettner rotorship is 295 ft. long, 48 ft. 3 in. beam and draws 19 ft. A single propeller is coupled by hydraulic transmission to two Diesel engines of 530 hp. each. The three rotors, each 13 ft. in diameter and 56 ft. high, are driven by small motors and add the equivalent of from 500 to 1,000 hp., depending on the wind velocity. She has already made two cargo trips through the Mediterranean.

Photo by courtesy of F. O. Willhoft, consulting engineer, New York City



Large Diesels for Stand-by Service

By L. H. MORRISON

WHERE water flow is irregular, oil engines meet stand-by requirements satisfactorily. Unless coal be cheap, the Diesel's operating costs are lower than of like-sized steam plants..

THE ability of designing engineers to produce and the willingness of manufacturers to build Diesel engines of large capacity, ranging from 5,000 to 15,000 hp., is a direct challenge to the power user to prove that such units have or have not a place in power generation plans.

Examining first the central-station field, apparently the oil engine cannot compete with the large steam stations now using 1¼ to 1½ lb. of coal per kilowatt-hour. The oil engine has a superior thermal efficiency, but coal is enough cheaper than oil on a heat-unit basis to enable large steam plants to generate power at a lower cost. In addition, the capital investment of a Diesel plant is higher, making the total costs per kilowatt-hour higher.

This discussion gives no consideration to the use of large Diesels in plants now purchasing energy produced in steam plants. Depending upon circumstances, the oil engine may prove cheaper than purchased current, especially in cases where the line loss is considerable and the investment in the transmission equipment high.

Stand-bys for Hydro-Electric Systems

When the necessity of stand-by plants for hydro-electric developments is considered, it would appear that the Diesel may frequently prove an economical prime mover. Where there are definite periods of minimum water flowage, a modern high-pressure steam plant is probably the most advantageous of stand-bys. The plant can be shut down during the idle season and fired up only when the low-water season approaches. Such conditions exist in the Southeast where the public utilities depending upon hydro plants maintain steam plants, such as the Yadkin plant in North Carolina and the Tiger plant in South Carolina. The amount of labor carried the year around is small, and banking coal is of small tonnage.

When, however, the flow is irregular or uncertain, stand-by plants must be ready at all times to carry the load. This requires that the fires be kept banked and at one pound per hour per 30 kw. rating of the plant, the coal so consumed amounts to a high figure in a year's term and, together with the labor constantly on duty, makes the power costs high.

The success of a hydraulic development depends upon being able to dispose of all power that can be generated, which in turn results in the system being loaded beyond the plant's capacity at low-water periods. This condition exists in places where prior water rights of lower down the river prevent the utility from impounding the water during low-load periods. Stand-by plants are then necessary. When one considers the banking costs of steam plants, the oil-engine plant works out as the more economical when the period of actual operation is less than 2,500 hours per year.

The characteristics that must be considered when the choice of stand-by equipment is being made are: Readiness to serve, low stand-by losses, reliability, low first cost, low depreciation, a small labor charge and low fuel costs.

Readiness to serve is the outstanding characteristic of the Diesel engine. It is possible to start the engine from a cold condition and have it carry full load within five minutes. The greater part of this time is given up to the manipulation of the switches and synchronizing apparatus. Conversely, it can be stopped at instant notice without loss such as occurs in a steam plant due to the steam passing out the safety valve and to the unconsumed coal on the stokers.

As the oil engine uses no fuel save when in motion,

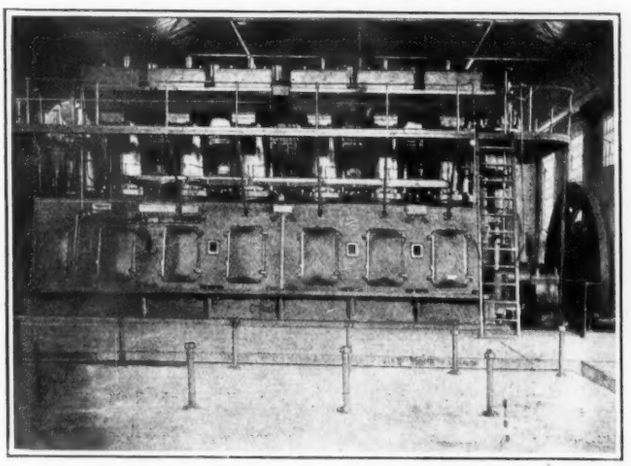


Fig. 1—A 1,000-hp. Diesel of this design is used in a New York hydro-electric plant as a stand-by

stand-by losses disappear. In reliability there is little to choose between a well-designed oil engine and a well-planned steam plant. Both are subject to unexpected trouble but a well-built Diesel will operate over 95 per cent of the time. In addition, no delay for cooling before making a repair, or for warming up after the adjustment is made is necessary. A well-organized force can remove and replace a piston in two hours and remove a main bearing in a lesser period.

Formerly, there was a notable discrepancy between the initial costs of a steam and a Diesel plant. Of late oil-engine prices have decreased to a point where a complete plant costs little if any more than will a high-pressure steam plant. Diesels have sold for $40 f.o.b. factory; adding to this freight, foundation, piping, electrical equipment, etc., the cost will run less than $100 per kw. for large capacity units. This will compare favorably with steam equipment.

Depreciation of machinery occasions more argument

than any other detail of costs. Usually, those who insist on a large depreciation charge are actually basing the claim on obsolescence rather than depreciation. The latter covers wear and tear, and it is assumed that by setting up a depreciation account the capital investment will be repaid by the time the machine wears out. Obsolescence is a charge placed as a protection against

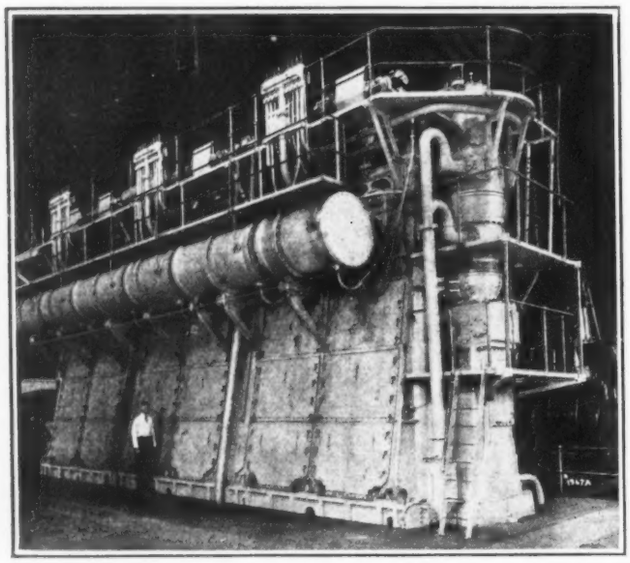


Fig. 2—This engine was installed in a Nevada mine during a water shortage

the advent of a more economical apparatus, which in many times occurs within ten years, or even five years. For example, a steam plant installed ten years ago may by now be out of date. An obsolescence charge is no doubt proper against certain types of machinery, but it is not reasonable to place such a burden on an oil engine when comparing costs. The efficiency of the first commercial Diesel has not been surpassed by later designs. By pure wear and tear the oil engines should not be ready for the scrap pile within 25 years, and a depreciation of 4 per cent is not too small.

Comparative Costs

The labor charge of a Diesel, if one includes all station employees, is somewhat less than in a steam plant.

Fuel costs, as has been mentioned, are higher with an oil-engine plant than in a modern steam plant of large capacity. This, of course, is not true when coal must have a long haul or when oil is cheap.

A tabulation of stand-by station costs assuming that a 10,000-kw. plant is actually operated 2,000 hours per year at full load, works out about as follows on a basis of yearly total cost per kilowatt capacity:

	Steam	Diesel
Labor	$3.20	$2.00
Fuel—Coal @ $6, oil @ 5 cents	9.00	9.09
Banking	0.67	
Oil and supplies	.20	.75
Fixed charges *	15.00	12.00
Total per kw. capacity	$28.07	$23.84

* Steam fixed charges: 6 per cent interest; 7 per cent obsolescence; 2 per cent insurance and taxes. Diesel fixed charges: 6 per cent interest; 4 per cent depreciation; 2 per cent insurance and taxes.

Other factors remaining unchanged, coal must be purchased at approximately $3 per ton to equal the Diesel costs, or with the fuel prices unchanged, the Diesel could cost $136 per kw. instead of $100, and still equal the steam plant costs.

It is questionable if stand-by plants should be located close to a hydro development. It is seldom that energy is sold without a considerable prior transmission. While small steam stand-by plants cannot economically be installed close to the various load centers, the small Diesel plant has the same fuel consumption per unit of power as have the large engines, and the investment cost is only slightly higher. The difference in labor and fixed charges would be offset by the elimination of the transmission line loss. From a contemplation of automatic electric substations the thought arises that an equal amount of research would result in the development of the oil engine automatic substation or stand-by plant. While this may sound impracticable, there is no basic obstacle. The oil engine can be made automatic in starting, paralleling and stopping, and as for attendance, many existing plants receive a minimum of care from the operating force.

Industrial Stand-by Plants

Under certain conditions existing in industrial plants when energy is purchased from hydro-electric, or even steam, power systems, a stand-by may prove economical. If secondary, or off-peak, service is obtainable at a price less than the cost of fuel, it may pay to use secondary power and install a Diesel stand-by to use when the purchased energy is withheld. As at 5 cents per gallon the Diesel fuel cost is approximately 4½ mills, secondary energy at 4½ mills or less when primary power is above 1 cent would justify the installation of a Diesel or a highly economical steam plant at the factory. There

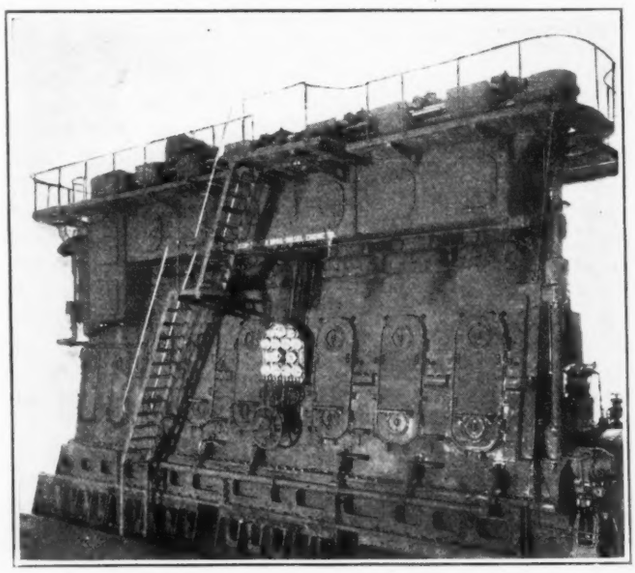
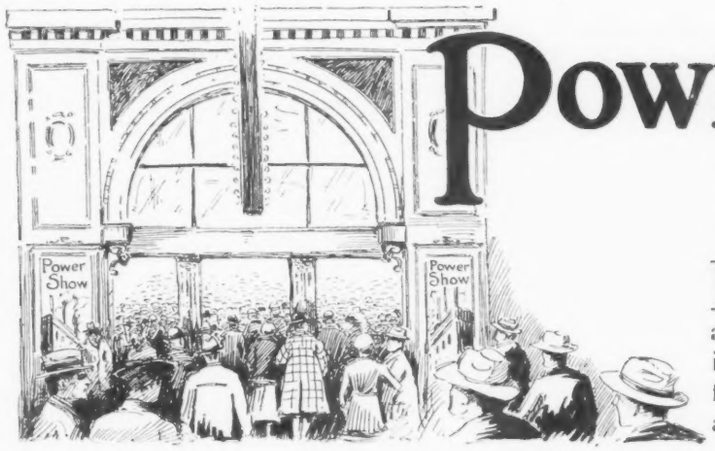


Fig. 3—A modern 4,000-hp. Diesel suitable for stand-by service

is in addition a reduction in insurance rates consequent upon the existence of a stand-by source of power.

A number of Diesel stand-by plants are in existence. Among the notable installations are three 3,750-hp. units for the Panama Canal. Another plant is the Diesel stand-by pumping plant of the Chicago Sanitary District, although after installation the units were put into constant service.



POWER SHOW 1926

FIFTH Annual Power Show exhibitors total over four hundred and seventy. Progress and development in the power-plant equipment field reflected in the number of improvements and new equipment that will be seen.

THE Fifth National Exposition of Power and Mechanical Engineering, which will be held in the Grand Central Palace, New York City, Dec. 6 to 11, will be notable for the large increase in the number of exhibitors and in the size and quality of the exhibits as a whole.

The increase in the number of exhibitors has necessitated allocation of space on the fourth floor where about 75 manufacturers will have booths.

Working models and sectioned pieces of equipment will be more in evidence than heretofore. The manufacturer appreciates that this is one of the best ways to demonstrate his product and make his exhibit of educational value as well. It also affords engineers the opportunity for obtaining first-hand information from the manufacturer or his representative on any operating difficulties he may be having with certain pieces of equipment in his own plant, and by visiting the show he approaches the equivalent of a visit to the home offices or plants of about 400 manufacturers.

A Departure in Boiler Design

Outstanding in the field of boiler design will be a model of a new steam generator that is a radical departure from the usual practice. A feature of this steam generator is the employment of long tubes of small diameter ($\frac{5}{8}$ in. O.D.) into which an over-sufficient supply of water is injected at the top end through a small orifice. The steam generated in the tubes, together with the unevaporated water, is discharged at the bottom end to a separating drum where the steam is liberated and from which the water is recirculated through the tubes.

One of the superheater manufacturers will display units taken from superheaters in service for a number of years in Hell Gate station, New York, and the Fordson plant at Detroit. This will afford an opportunity to study the results of operation at high temperatures and under severe operating conditions.

Included in the line of air heaters and furnace draft equipment will be a tubular air heater with lead-coated tubes and a high-speed induced-draft fan which can be readily installed by cutting out a part of the flue or duct and inserting the fan, as the line of air flow is a straight line.

Another new development, which will be at the power show for the first time, will be a feed-water regulator in which the feed valve is controlled by the drop in pressure between two orifices through which a constant flow of steam and water is maintained from the water column, the pressure operating the feed valve being a function of the percentage of water in the steam passing through the orifices.

A feature of the exhibits of centrifugal boiler-feed pumps will be a multi-stage unit for pressures up to 1,500 lb. equipped with a hydraulically balanced device to neutralize the end thrust on the impeller shaft.

Although there has been no outstanding development in the field of pulverized-fuel equipment during the last year, many improvements have been made on the various types of apparatus.

Of special interest to those using pulverized-fuel and stoker-fired boilers will be the various sizes of stationary and portable pneumatic sweeping systems for removing coal sifting from beneath stokers and general cleaning of floors, tops of boilers, etc. In addition, dust collectors with special dumping bottoms for rapid disposal of the accumulated coal and dust will be shown.

Many improvements in the line of motor-operated valves for high pressures and temperatures, as well as new types of valves, will be found at the show. These will represent the latest achievements in high-pressure valve design and in the method of operating the valve through push-button remote controls.

Welding Apparatus for the Power Plant

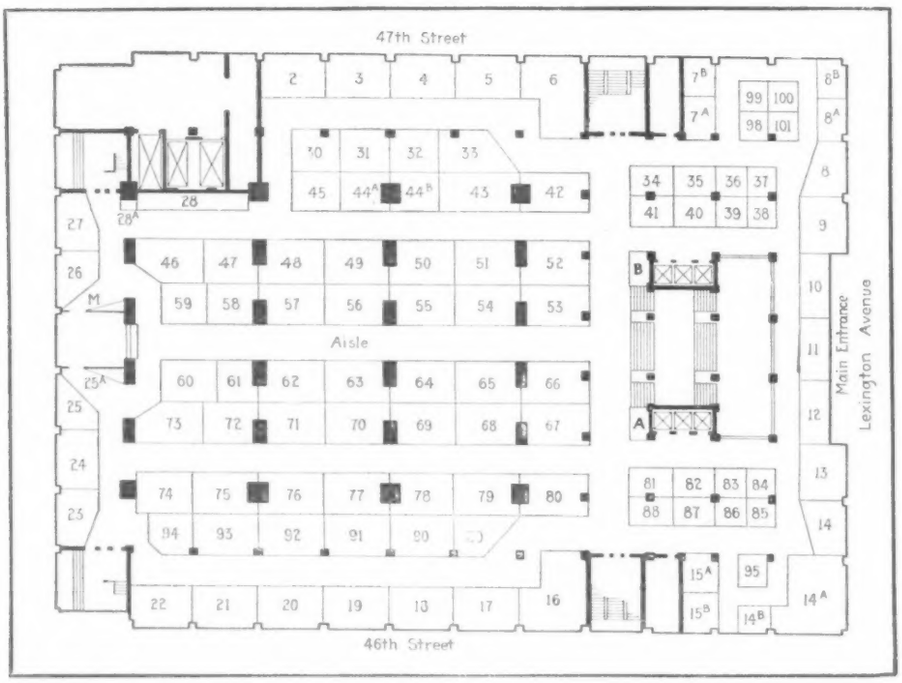
The part that oxyacetylene and electric welding are playing in power-plant maintenance will be emphasized by the several manufacturers displaying apparatus for this purpose.

As in former years, boiler-room instruments of all types will form a conspicuous part of the exhibit, and many new models will be found, including a flow meter that operates on the inductance bridge principle.

The annual meetings of the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers will be held during the week of the show, as in former years.

The foregoing presents a few high spots of the exhibits, but the reader is referred to the following pages for a list of the manufacturers, their booth numbers and their products.

What the Manufacturers Will Exhibit



First Floor Plan and Booth Numbers

Booth A—Edwin Burhorn Co., New York City. Working models of cooling tower "packers" type, model of recent development in cooling surface consisting of cast-iron interlocking ends, model of louver construction designed to reduce deterioration due to rusting. Representatives: Edwin Burhorn, C. A. Harry, W. Hennings, H. A. Stover, Jr. G. G. Harrison, C. Dahlquist.

Booth 2—The Chapman Valve Co., Indian Orchard, Mass. Complete line of chrome-nickel steel gate valves and fittings for high pressure and temperature service; Chapman motor unit in operation; line of iron-body gate valves for water and steam and a line of brass valves for general service; Information on the causes of bolt failures under severe conditions will be available.

Booth 3—The Permutit Co., New York City. Model of water softening and filtering equipment such as is used in industrial plants. Representatives: A. G. Smith, R. W. Epple, A. F. McConnell, F. D. West, L. E. Burkee, J. S. Shedden and F. D. Harger.

Booth 3—Keystone Lubricating Co., Philadelphia, Pa. A small machinery unit completely equipped with the Keystone safety lubricating system, also greases for all mechanical conditions.

Booth 4—Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, Pa. Motor- and cylinder-operated gate valves, high-pressure valves, fittings and piping.

Booth 4-5—General Electric Co., Schenectady, N. Y. Steam turbines, motors, motor controls, flow-meter equipment, battery charging outfits and blowers. Representative, W. G. Gluesing.

Booth 6—Republic Flow Meters Co., Chicago. Complete line of Republic instruments including flow meters for steam, water, air and gases; boiler meters, pyrometers, indicating and recording CO_2 meters, draft indicators and recorders, coal meters, combination steam-flow CO_2 recorders Liquid level and pressure recorders and indicators, manometers and producer gas control unit. The latter unit is a new development of this company.

Booths 7A and B—Yarnall-Waring Co., Philadelphia, Pa. Line of Yarway blowoff valves for all working pressures, including a new type C valve with protected packing features for pressures up to 900 lb., also involute spray nozzles with combination humptee and special type spray nozzles. A feature of the exhibit will be a Yarway-Lea V-notch recording liquid meter in operation giving a continuous reading of water flowing through a sectioned tank with a hook gage attachment by which the meter can be checked at any period in its operation. Representatives, L. G. Chase, J. T. Newman and C. H. Thompson.

Booth 8—Bundy Steam Trap Co., Nashua, N. H. Improved Bundy steam trap in which are incorporated ground joints at trunnion and elbow connections, knife-edge bearings for bowl, lever and connecting rods, monel-valve seats and disks and shock-absorbing attachments on the lever rod.

Booth 8A and 8B—National Tube Co., Pittsburgh, Pa. Seamless tubing, boiler tubes, pipe and flanges.

Booth 9—The International Nickel Co., New York. Commercial forms of monel metal and nickel alloys. Also a collection of important parts of power-plant equipment as produced by the various manufactures.

Booth 10—Boig & Hill, New York City. Complete line of "Curtis" steam specialties.

Booth 10—Julian D'Este Co., Boston. "Curtis" engineering specialties including damper regulators, reducing valves, traps and temperature regulators.

Booth 10—Philadelphia Gear Works, Philadelphia, Pa.—Complete line of spur- and worm-gear reduction units.

Booth 10—Southern Power Journal, Atlanta, Ga.

Booth 11—Keystone Refractories Co., New York City. Dura-stix bonding mortar, steel veneer granular refractory, and a refractory sprayer for coating furnace linings and general repairing.

Booth 11-A—The Roto Co., Hartford, Conn. Boiler-tube cleaners, handhole seat scrapers, cap cleaning and reseating machine. Representatives, W. M. Kelley and J. W. Doherty.

Booth 12—The Bristol Co., Waterbury, Conn. Recording pressure and vacuum gages, electric temperature-control indicator and recording thermometers and pyrometers, water-level indicators.

Booth 13—Dearborn Chemical Co., Chicago, Ill., Feed-water treatment, oils, greases and rust preventive.

Booth 13—McLeod & Henry Co., Troy, N. Y. "Steel mixture" firebricks, veneer wall blocks, high-temperature cements, and flat suspended arches. Representatives, F. V. Tuthill, N. S. Burnham, T. J. Fitzpatrick, C. N. Morgan and A. L. Reeler.

Booth 14—Celite Products Co., Los Angeles, Calif. A sample boiler furnace wall showing the methods of installing insulation behind the firebrick, drawings illustrating the methods of insulating various types of boilers and furnaces. Also a small demonstration furnace

partly insulated and partly uninsulated to show the effectiveness of insulation in saving heat.

Booths 14-A, 14-B—Carrier Engineering Corp., Newark, N. J. Complete centrifugal refrigeration unit using dielene as the refrigerant. Also picturization of the carrier system of theater cooling, applications of conditioned air in the drying and processing of materials and application of air conditioning in industrial plants.

Booth 14-B—Cutter Electrical & Mfg. Co., Philadelphia, Pa. Circuit breakers.

Booth 15-A—Tide Water Oil Sales Corp., New York City. Petroleum products.

Booth 15-B—The Coen Co., San Francisco, Calif. Mechanical and steam atomizing oil burners, oil heaters, registers and strainers.

Booth 16—Diamond Power Specialty Corp., Detroit, Mich. A miniature boiler arranged to demonstrate the principles of the correct application of soot blowers to varying boiler conditions, motion pictures showing the application of soot blowers on oil-fired boilers. Representatives, Norman L. Snow, W. P. Thomas, G. L. Davis, L. W. Nones, J. E. Heeter, R. L. Townsend, H. D. Folinsbee, Jr., C. R. Vincent, H. W. Gilson and Robt. June.

Booth 16—Payne Dean, New York City. Direct and remote-control systems for operating valves.

Booth 17—Vincent-Gilson Engineering Co., New York.

Booth 17 — Andrews-Bradshaw Co., Pittsburgh, Pa. Tracyfier (steam purifier) in operation.

Booth 18—The Engineer Co., New York City. Balanced-draft furnace pressure regulator Turner baffle walls and Enco oil-burning system, including steam and mechanical atomizing burners.

Booth 19—Kissick-Fenno Co., Inc., New York City, Feed water regulators, soot cleaners and hand stokers.

Booth 19—Northern Equipment Co., Erie, Pa. "Copes" feed-water regulators and condensation controls, pump governors and valve-movement indicators.

Booth 19—The Vulcan Soot Cleaner Co., Du Bois, Pa. Self-contained valve operating head and ratchet operating soot-cleaner head, also cleaner parts, such as clamps, bearings, nozzles and high-temperature heat-resisting elements.

Booth 20—Power Specialty Co., New York City. Samples of Foster superheaters including convection and radiant-heat types. Samples of Foster economizer construction. Sections of water-cooled furnaces, photographs of installations, drawings and typical small parts used in construction work. Also, Aero unit coal pulverizer. Representatives, W. E. Dowd, R. H. Wyld, Paul Buckler, G. B. Van Twyl, J. Sengstoken, S. O. Loville, F. G. Page, J. E. Kenney, G. B. Ferrier, Jr., P. W. Foster, T. H. Wilkins, J. K. Seabright and D. O. Pendleton.

Booth 21—Hagan Corp., Pittsburgh, Pa. Combustion-control apparatus, deconcentrators and steam purifiers.

Booth 22 — The Carborundum Co., Perth Amboy, N. J. Carborundum and Aloxite refractory shapes and cement suitable for use in high-temperature boiler and industrial furnaces, water gas generator, oil refining still and a *carboradiant chamber* which makes possible the application of heat by radiation, burning oil, gas or pulverized coal. Representatives, C. E. Hawke, J. A. King, J. G. Fritzinger, S. W. Miller and S. A. Lenno.

Booths 23, 24, 25—International Combustion Engineering Corp., New York City.

Booths 23, 24, 25—Combustion Engineering Corp., New York City. "Lopulco" pulverized fuel burner, "Couch" burner for horizontal firing, pulverized fuel feeder, unit-system pulverizing mill, section of fire furnace of the self-supporting type and water-cooled wall construction, two full-sized elements of the C-E air heater. Several important parts of **Coxe** traveling grate and **Green** forced-draft stokers. Also scene in action displays of the Lopulco system and the steam generator. Representatives—officials and sales dept. staff of New York office.

Booth 24—Raymond Bros. Impact Pulverizer Co., Chicago.

Booth 25—Ladd Water Tube Boiler Co., Pittsburgh.

Booth 25—Green Engineering Co., East Chicago, Ind.

Booth M—The Mercon Regulator Co., Chicago, Ill. Various types of mercon pressure regulators. A feature of the exhibit will be actual working charts reproduced from charts obtained from a large central station to show the advantages in the smoothing out of steam and water flows and water level in the drum. Representatives: E. S. McCarthy, D. H. Skeen and D. S. Walker.

Booth 26—Reeves Pulley Co. Variable-speed transmission equipment.

Booth 26—Stewart-Sayers Co., New York City. Oil purifying apparatus for engine and transformer oils.

Booth 27—F. W. Dodge Corp. Sweets Engineering Catalog.

Booth 28—The Permutit Co., New York City. Ranarex instruments for recording CO_2, gas density, ammonia gas, etc.

Booth 28—Paulsen Spence Co., Inc. "Sterling" boiler feed systems, steam traps, reducing valves and regulators.

Booth 28—V. L. Sherman, care Lewis Institute, Chicago, Ill. Isometric pipe layouts.

Booth 28B—Engineers Book Shop, New York City. Technical books.

Booth 30—Edward Valve & Mfg. Co., East Chicago, Ind. Cast-steel stop and non-return valves, for pressures up to 900 lb., blowoff, atmospheric relief and check valves.

Booth 31—L. R. Merritt & Co., New York City. Steam specialties.

Booth 31-32—Springfield Boiler Co., Springfield, Ohio. Working model of the Springfield boiler, also parts showing details of construction.

Booth 33—Sarco Co., Inc., New York City. Thermostatic steam traps, temperature regulators and strainers. Also heating specialties for vacuum, vapor and pressure heating systems, including packless inlet valves and thermostatic radiator return traps. Representatives: E. J. Ritchie, R. W. Cumming, R. S. Doerr and J. L. Bruns.

Booth 34—The Brown Instrument Co., Philadelphia, Pa. Flow meter with indicating, recording and integrating instruments, electric CO_2 meters, resistance thermometer, pyrometers, pressure and vacuum gages and tachometers.

Booth 35—Fisher Governor Co., Marshalltown, Iowa. Pump governors, reducing valves, steam traps, float valves, and liquid level controllers both direct connected and remote controlled.

Booth 36-37—M. T. Davidson Co., New York City. Steam and centrifugal pumps, working models of certain types of equipment. Representatives: John Lowe, W. E. Brennan, H. A. Prindle, T. J. Rogers.

Booth 38—Ashton Valve Co., Boston. Single and duplex pop safety valves. Indicating and recording pressure gages, master pilot pressure gages master pilot pressure gages and dead weight gage testers.

Booth 40—Manufacturers Record, Baltimore, Md.

Booth 41—Furnace Engineering Co., New York City. A type 3A Simplex Unit pulverizer equipped with independent motor-driven feeder and magnetic separator together with fuel piping and burners. Also an illuminated description of the simplex system showing the coal in its raw state travelling through the pulverizer and ultimate burning in the furnace. Representatives: W. C. Drake, H. Buchert, E. B. Priebe, I. S. Forde, H. S. Weber, E. H. Striegel, C. H. Baker, F. E. Brandis, H. D. Moore, Dr. Paul Hirsch, and T. A. McGee.

Booth 42—*Power*, New York City.

Booth 43—Connery & Co., Inc., Philadelphia, Pa. Air-cooled damper and wagon top breeching with special expansion stiffeners. Representatives: W. M. Connery, C. B. Nicholson, A. D Stewart, W. J. Henderson, W. E. Gaunt.

Booth 44A—Walworth Co., Boston. Sigma steel valves, and fittings, brass and iron body valves, power piping and Stillson wrenches.

Booth 44-A—Watts Regulator Co., Lawrence, Mass. Reducing valves and pump governors.

Booth 44B—Lewis M. Ellison, Chicago, Ill. Single and multi-tube inclined and vertical draft gages, *pointer draft gage* and *U-path steam calorimeter*.

Booth 45—Uehling Instrument Co., Paterson, N. Y. Standard line of CO_2 recorders and waste meters, vacuum recorders, combined barometer and vacuum recorders and pyrometers. Also *automatic control apparatus*. Representatives: C. C. Phelps, C. J. Schmid, F. D. Bogia, P. J. Riccobene.

Booth 46—Flynn & Emrich Co., Baltimore, Md. "Huber" hand and mechanical stokers.

Booth 47—Peabody Engineering Corp., New York City. Peabody, fuel oil, gas and pulverized coal burning equipment and viscosity regulator.

Booth 48—American Chain Co., Bridgeport, Conn. Chains for cranes, hoists and other uses.

Booth 48—Reading Steel Casting Co., Bridgeport, Conn. Improved line of steel valves designed to eliminate warping at high temperatures, having new design of body and wedge with trimmings of rustless steel.

Booth 48—Pratt & Cady Co., Bridgeport, Conn. High- and low-pressure globe and gate valves.

Booth 49—The Griscom-Russel Co., New York City. U-fin air coolers, bent-tube evaporators, multiwhirl cooler and Reilly water heater.

Booth 50—R. H. Beaumont Co., Philadelphia, Pa. Complete working model of coal and ash handling system for boiler plants. This system includes cable drag scraper and skip hoist. Representatives: R. H. Beaumont, E. A. Thumlert, T. G. Weygandt, H. W. Ruth and J. A. Beck.

Booth 51—Bailey Meter Co., Cleveland, Ohio. Different styles and sizes of meter panel boards and a complete line of boiler meters, fluid meters, pressure and temperature recorders, tachometers and multi-pointer gages. A Bailey meter control for automatically regulating the supply of fuel and air to the boiler furnace will be in operation. A special feature of the exhibit will be a section of pyrex glass pipe through which water will be circulating at different rates of flow to demonstrate the effect of various pipe fittings upon the flow of fluid.

Booth 52—Crane Co., Chicago. Line of cast-steel valves for various working pressures up to 900 lb., iron and brass body valves in the angle, globe and gate types, new design of receiver type steam separator, also samples of an improved design of forged-steel globe and gate valves. All of the cast- and forged-steel valve shown will be trimmed with exelloy, a stainless steel.

Booth 53—Combustion Publishing Co., New York City.

Booth 54—Fuller-Lehigh Co., Fullerton, Pa. Fuller-Kinyon transport pump for pulverized coal, single screw feeder, models of pulverizing mill, horizontal burner and Randolph waste-heat drier, Bailey feeder and meter, turbulent burners and Bailey furnace wall. Representatives: E. G. Bailey, E. J. Billings, J. B. Gaffney, R. Galt, H. G. Barnhurst, H. B. Jones, T. A. Scheffler, T. W. Marso, A. P. Hachtmann, R. A. Hawk.

Booth 55—Babcock & Wilcox Co., New York City. Construction of water-tube boilers, superheaters and tubular air heaters.

Booth 56—Superheater Co., The, New York City. Superheater units. A feature of this exhibit will be units taken from superheaters in service for a number of years at the Hell-Gate Station, United Electric Light & Power Co., New York and the Fordson plant of the Ford Motor Co., Detroit, Mich. This exhibit will afford an opportunity to study the results of operation at high temperatures and under rather severe operating conditions. Representatives: B. R. Bristol, B. N. Broido, D. S. Carter, A. H. C. Dalley, R. M. Gates, F. A. Schaff, V. W. Smith, L. H. A. Weaver, R. L. Ehrmann.

Booth 57—Otis Elevator Co., New York City. Commercial steel castings made by the electric furnace process, a large steel valve weighing about 4,000 lb. and tested at 2000 hydrostatic pressure. Control valves for high pressure and superheat, hardening pots made from a heat resisting composition, magnet rings and spiders of dynamo steel and miscellaneous steel castings.

Booth 58—American Arch Co., Inc. Full-sized model of "American" suspended arch, arch lock brick and tile and section of air-cooled side wall. Representatives: J. A. Lodwick, H. A. Maunshardt, F. D. Hazen, M. V. Kay, R. G. Strever, W. B. Tardy, E. Smiley, J. G. Tyrrell, F. M. Willet and K. H. Woolson.

Booth 58—Waite & Davey Corp., Inc., Long Island City, N. Y. Air-cooled furnace arches and blocks.

Booth 59—C. J. Tagliabue Mfg. Co. A feature of this exhibit will be the 1927 Model Mono duplex Recorder for indicating and recording the percentage of CO and CO_2 in flue gases. This instrument is fitted with large illuminated dial and red and black pointers The red pointer serves to warn the operators when the CO_2 falls below a certain value. Other instruments shown will be recording and indicating dial thermometers, recording pressure and vacuum gages, automatic controllers for temperature, pressure and humidity, viscosometer, hydrometers, etc.

Booth 60—Manning, Maxwell & Moore, Inc., New York City. Ashcroft gages and specialties. Consolidated safety valves, Metropolitan injectors and Hancock valves of bronze, cast steel and forged steel.

Booth 61—L. J. Wing Mfg. Co., New York City. Turbine blowers for stokers and hand-fired plants, motor-driven blower for low-pressure heating boilers, speed regulators for controlling the speed of motor-driven blowers, automatic regulator for starting and stopping a motor-driven blower to maintain constant room temperature, low ceiling type, featherweight unit heater, a scruplex exhauster on which the motor is removed from the exhaust housing, and a scruplex fan which moves the air in straight parallel lines. Representatives: A. E. Seelig, H. S. Wheeler, V. H. Corples, C. F. Smith, C. L. Meyer, C. H. Smith, J. H. Carbone.

Booth 62—The Foxboro Co., Inc., Foxboro, Mass. Boiler water level gage in operation connected to a standard water column. Flow meters and flow controllers, complete line of Foxboro instruments displayed on panels and a complete instrument installation for a small plant including a CO_2 meter recording pressure gage, flue-gas thermometer and a draft gage.

Booth 63—The Lunkenheimer Co., Cincinnati, Ohio. A feature of this exhibit will be a 10-in. 400-lb. non-return valve which will oe unpainted, also steel gate valves electrically operated. In addition, sectioned samples of gate, globe, check and blowoff valves and small steel monel metal and bronze valves will be shown.

Booth 64—Wheeler Condenser & Engineering Co., Carteret, N. J. Model of a surface condenser equipped for reversing the water flow to aid in cleaning the condenser, also evaporator, cooling towers, steam-jet air pumps and expansion joints.

Booth 65—Anaconda Copper Mining Co., New York City. Admiralty and muntz metal condenser tubes, nickel bronze turbine blading, Tobin bronze piston rods and shafting, copper bus-bar and tubes.

Booth 65—American Brass Co., Waterbury, Conn. Line of brass, copper and nickel silver materials such as condenser tubes, steam and hot water tubing; Tobin-bronze piston rods and shafting, rectangular and tubular bus bars and various grades of welding rod.

Booth 66—Nash Engineering Co., So. Norwalk, Conn. Jennings-Hytor vacuum and condensation pumps for heating systems, compressors, pumps, and sewage ejectors.

Booth 67—Cochrane Corp., Philadelphia, Pa. Deaërating heater, strainerless conical filter, flowmeter of the indicating, recording and integrating type with temperature recorders, orifices and flow nozzles, multiport back-pressure valves, vertical and horizontal steam and oil separators and high- and low-pressure traps. Representatives: J. S. L. Wharton, J. C. Jones, H. E. Sibson, A. B. Wallem, J. D. Yoder, P. S. Lyon, J. B. Fowler, J. E. Harris, G. H. Gibson, A. Drescher, Chas. Wharton, J. S. L. Wharton, Jr., F. E. Idell, W. W. Montalvo, F. B. Sage and A. R. Foote.

Booth 68—The Bigelow Co., New Haven, Conn. Photographs and drawings of Bigelow-Hornsby water-tube boiler with and without integral steel economizer and also with a combination slag screen and water-cooled bridge wall.

Booth 69—Scovill Mfg. Co., Waterbury, Conn. Cup-drawn admiralty condenser tubes, muntz condenser tubing, general brass products such as sheet, rod, wire, tubing, and forgings.

Booth 70-71—Bethlehem Shipbldg. Corp. Ltd., Bethlehem, Pa. Diesel engines, oil-burning pumping and heating equipment. Bethlehem-Wier and centrifugal boiler feed pumps.

Booth 70-71—Bethlehem Steel Co., Bethlehem, Pa. Bethlehem coal pulverizer of the roll-tire type with dust-proof bearings.

Booth 72—M. W. Kellogg Co., Jersey City, N. J. Samples of forged welded tongue and groove flanged joints, Kellogg VanStone pipe joints, forge welded pipe nozzle and copper-plated expansion joint.

Booth 73—Buffalo Steam Pump Co., Buffalo, N. Y. A new type high-speed high-head single-stage centrifugal pump, single and multi-stage centrifugal pumps for various services.

Booth 73—Buffalo Forge Co., Buffalo, N. Y. Fans, blowers, exhausters, air coolers and purifiers.

Booth 74—American Schaeffer & Budenberg Co., Brooklyn, N. Y. Indicating and recording gages and thermometers pop safety and relief valves, calorimeters dial thermometers and control apparatus for pressure, temperature and humidity.

Booth 75—Allen-Sherman-Hoff Co., Philadelphia, Pa. A. S. H. Hydro-jet ash handling system, cast-iron bunkers, air-cooled furnace bottoms, ash hoppers and gates.

Booth 76—Sowdon & Greene, New York City. Products of Simplex Valve and Meter Co., Ernst & Co. and the National Co.

Booth 76—Simplex Valve & Meter Co., Philadelphia, Pa. Simplex hot and cold water meters of the indicating recording and totalizing types and a simplex indicating manometer.

Booth 76—Ernst & Co., Newark, N. J. Water columns with inclined gage glass also gage glass valves.

Booth 76—National Co. Water column illuminators.

Booth 77—C. H. Wheeler Mfg. Co., Philadelphia, Pa. Sectional model of a two-stage radojet air pump, a new type twin drain control for removing condensate from the inter and after condenser; a three-stage radojet with two barometric inter condensers for producing a high vacuum with 70-deg. injection water. Also photographs of condensers and condenser installations.

Booth 78—Bernitz Furnace Appliance Co., Boston, Mass. Standard ventilated blocks and shapes. Full size layout of "S-100" series Carbo frax super blocks and a "TU" pulverized-fuel furnace lining.

Booths 78-79—Riley Stoker Corp., Worcester, Mass. An "Atrita" unit coal pulverizer and a short-flame flare-type burner arranged for three supplies of air. A two-retort Riley standard stoker equipped with a new type grate block. Also a new type poppet valve for operating "Jones" stokers.

Booth 79—Murphy Iron Works, Detroit, Mich. Mechanical stokers.

Booth 80—American Society of Mechanical Engineers, New York City.

Booth 81—The Paul B. Huyette Co., Philadelphia, Pa. Weight and chain operated gage cocks, gage-glass protector, safety water column, Hays gas analysis instruments and draft gages, General Electric flow meters, and water-column adapter. Representatives: Paul B. Huyette, W. C. Edge, A. F. Bittner, H. R. Blessing, J. J. McCarthy, S. L. Huyette and P. Wood.

Booth 81—Hays Corporation, Michigan City, Ind. Gas Analyses instruments and draft gages.

Booth 81—The Reliance Gauge Column Co., Cleveland, Ohio. Sectional samples of electric alarms, valves and gage cocks and models showing the process of producing nickel floats without seams or joints; Sectioned and trimmed water columns for 250, 425 and 650 lb. pressure. For the latter pressure the column is made of extra heavy all forged steel and equipped with special heavy-duty fluoborate nickel floats and alarm valves with monel seats and chrome-silicon disks. In addition heavy-duty gage cocks for 1500 lb. will be shown. Representative, J. Rowland Brown.

Booth 82-83—National Engineer, Chicago.

Booth 84—Foster Engineering Co., Newark, N. J. Several different types of pressure regulators and pump governors, also back pressure and relief valves, float valves for steam and water, automatic stop and check valves, through bolt bonnet type non-return stop valve, fan engine regulators, flexible ball joints and flow box in practical demonstration. Representatives: C. A. Olson, W. E. Ward, J. D. Rostron, G. H. Bauer, W. E. Heck and W. R. Lodewig.

Booth 85—Smith & Serrell, Newark, N. J. "Franche" flexible couplings, including the bushed laminated pin, floating ring, high speed and marine types; Couplings will be shown in operation.

Booth 86—G. G. Atlas Systems, Inc., New York City. "Atlas" pneumatic-tube systems.

Booth 86—Lead Lined Iron Pipe Co., Wakefield, Mass. Lead- and tin-lined iron pipe valves, fittings and stop cocks.

Booth 87-88—Gillis & Geoghegan, Inc., New York City. Hand and electric operated telescopic hoists for ash removal.

Booth 89—Quigley Furnace Specialty Co., New York City. "Hytempite" for bonding firebrick and patching furnace linings, ganisand for making rammed-in linings and special shapes, acid-proof cement for bonding and surfacing masonry and the Quigley refractory gun for furnace repairing.

Booth 90—Jenkins Bros., New York City. Full line of bronze and iron valves in both globe and gate types. New type modulating valve, rapid action valve, lever operated and *quick-opening steam valves*.

Booth 90—Babbitt Steam Specialty Co., New Bedford, Mass. Chain-operated valve wheels and specialties.

Booth 92—James T. Gordon Co., New York City. "Nicholson" steam specialties, strainers, vacuum pumps and reduction gears.

Booth 92—W. H. Nicholson & Co., Wilkes Barre, Pa. Piston-operated steam traps. Several sizes of flexible shaft couplings.

Booth 92—Cleveland Worm & Gear Co., Cleveland, Ohio. Worm-gear speed-reduction units.

Booth 92—The Sharples Specialty Co., Philadelphia, Pa. A presuratite super-centrifugal for purification of fuel oil, a portable machine for dehydration of transformer oil, a machine in cross-section to show the operating principle.

Booth 93—Neemes Foundry Inc., Troy, N. Y. Operating sections of shaking and dumping grates and a hand operated stoker. Representatives, R. R. Rees, E. C. Welsh, and A. B. Taylor.

Booth 93—Plibrico Jointless Firebrick Co., Chicago, Ill. Plibrico furnace lining and monolithic furnace construction. A moving picture will show the process of installing a plibrico furnace lining.

Booth 94—M. H. Detrick Co., Chicago, Ill. Sectional supported side walls for pulverized coal furnaces, flat suspended furnace arch. Drawings and photographs of typical installations.

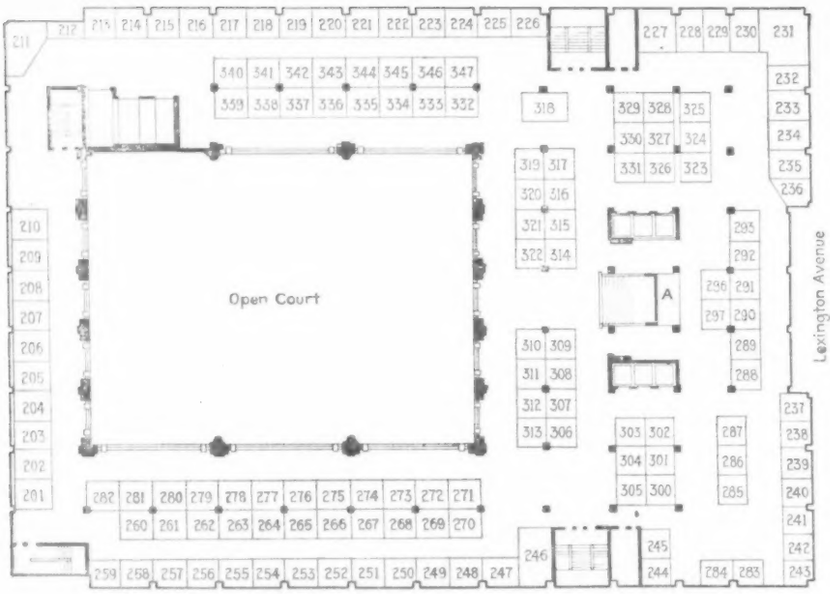
Booth 95—King Refractories Co., Buffalo, N. Y. "Mono" boiler baffles and furnace cements.

Booth 98—Crosby Steam Gage & Valve Co., Boston. Bronze, iron, steel and monel globe valves, safety blow-off and relief valves, indicating and recording gages, gage testers.

Booth 99—Power Plant Engrg., Chicago, Ill.

Booth 100-101—Everlasting Valve Co., Jersey City, N. J. Boiler Draw off (Wylie Wilson) process, regular line of everlasting valves including Model X tandem valve, companion *angle valve* for pressures up to 500 lb. Representatives, G. L. Prentiss, S. E. Carman, G. M. Elton, J. H. Allen, Wylie G. Wilson, and E. N. Corning.

THE Advisory Committee of the Power Show comprises the following members: I. E. Moultrop, chairman, Edison Electric Illuminating Co. of Boston; W. L. Abbott, president The American Society of Mechanical Engineers; Homer Adams, past president American Society of Heating and Ventilating Engineers; N. A. Carle, vice-president and general manager, Public Service Production Co.; James E. Davidson, president National Electric Light Association; W. H. Driscoll, president American Society of Heating and Ventilating Engineers; Fred Felderman, past national president National Association of Stationary Engineers; C. F. Hirshfeld, chief of research department, Detroit Edison Co.; O. P. Hood, chief mechanical engineer, U. S. Bureau of Mines; L. H. Jenks, president American Society of Refrigerating Engineers; E. B. Katte, chief engineer, Electric Traction, N. Y. Central Railroad; R. T. Kent, chairman Professional Divisions Committee, A.S.M.E.; John H. Lawrence, Thomas E. Murray Co.; Fred R. Low, editor of *Power* and past-president American Society of Mechanical Engineers; David Moffat Myers, consulting engineer; Fred W. Payne, co-manager of Exposition; H. B. Reynolds, chairman Power Division, A.S.M.E.; Calvin W. Rice, secretary American Society of Mechanical Engineers; Charles F. Roth, co-manager of Exposition.



Seen on the Second Floor

Booth A Mezz. Floor—The Timken Roller Bearing Company, Canton, O. Full line of Timken bearings for all kinds of industrial machinery. Also a device to show how the rollers in a Timken bearing are aligned. Representatives: L. M. Klinedinst, W. B. Moore, S. C. Merrill and A. G. Norris.

Booth 201—Liptak Fire-Brick Arch Co., Mexico, Mo. Type S furnace wall construction for pulverized coal furnaces, single- and double-suspension arches, special arch block of high alumina or diaspore material, also type X all refractory furnace wall construction.

Booths 201-202—A. P. Green Firebrick Co., Mexico, Mo. Special high alumina brick, high-temperature air setting cement, and special "quik pach" plastic firebrick. Also standard line of firebrick, special fireclay shapes, firebrick mortars and high-temperature cements. Representative, George E. Ford.

Booth 203—American Car & Foundry Co., New York City. "Berwick" Electric rivet and bar heaters and Halyburton valves.

Booths 204-205-206 — Detroit Stoker Co., Detroit, Mich. Full-sized underfeed stoker in operation. Special exhibits will demonstrate the mechanical drive and methods of controlling the fuel bed. Representatives, W. H. Rea, W. H. Riecks, R. L. Beers, F. B. Strale, H. B. Post, W. L. Higgins, H. W. Maitland, E. L. Beckwith, L. I. Snodgrass, J. M. Keylor, F. Willins and Robert June.

Booths 207-208-209 — The Terry Steam Turbine Co., Hartford, Conn. Flexible coupling of the pin and bushing type, herringbone-type reduction gear, single- and multi-stage turbines for high pressures and temperatures.

Booths 209-210 — Marion Machine, Foundry & Supply Co., Marion, Ind. Marion hand-fired stokers, type AB soot blower with valve in head, also Gulfstream water heaters.

Booth 211—E. Keeler Co., Williamsport, Pa. Working models of the Keeler return-tubular, cross- and long-drum water-tube boilers and also the double-duty boiler.

Booth 212—Alsop Engineering Co., New York City. Mixing machines and portable pumps.

Booth 213—The S. C. Regulator Mfg. Co., Fostoria, Ohio. Standard and high pressure feedwater regulators for pressures up to 1,200 lb., boiler feed-pump regulators, master control apparatus for any pressures up to 750 lb., special differential pressure regulating valves with variable excess pressure attachment.

Booth 214—The Ballwood Co., New York City. Samples of fabricated-steel and wrought-iron pipe with welded flanges and square-corner Vanstone joints, drilled lap joint and samples of special welding and forging.

Booths 215-216—Armstrong Cork & Insulating Co., Pittsburgh, Pa. Insulation materials for high temperatures and for refrigeration lines.

Booths 217-218—Seminole Chemical Co., Inc., New York City. System for cleaning of boilers and keeping them clean.

Booths 219-220 — Erie City Iron Works, Erie, Pa. Unitype coal pulverizer operating at slow speed. Drawings and illustrations of three-drum inclined water-tube boiler, also basket type water-cooled refractory-lined furnace for pulverized-fuel firing.

Booth 221-222—International Filter Co., Chicago, Ill. Hot- and cold-process water softeners, exchange type softener and miscellaneous equipment to meet the various problems of water purification.

Booths 223-224 — Mason Regulator Co., Boston. Mason line of pressure regulators, reducing valves pump-pressure regulators and speed governors, hydraulic damper regulators, float valves and strainers.

Booths 225-226—Warren Webster & Co., Camden, N. J. Modulation system of steam heating, packless valves, heaters, boiler return and vent traps.

Booth 227—Drake Non-Clinkering Furnace Block Co., Inc., New York City. Sections of air- and water-cooled furnace walls, furnace blocks and furnace-door safety latches.

Booth 228—The E. L. Keating Pipe Bending & Supply Co., Hartford, Conn. Samples of fabricated piping for high and low pressures, including reinforced square-corner Vanstone joints, welded flanges and nozzles, pipe bends and coils for refrigeration and chemical processes.

Booths 229-230—The Swartwout Co., Cleveland, Ohio. Centrifugal type separator for steam, oil and air, ventilators, low-pressure float type and high-pressure bucket type traps.

Booths 230-231—Warren Steam Pump Co., Warren, Mass. Single- and multi-stage centrifugal pumps, reciprocating pumps and separators.

Booths 232-233—Walter S. Dickson Co., New York City. Heating and ventilating apparatus.

Booth 232—Arca Regulator, Inc., New York City. "Arca" automatic regulators.

Booths 232-233—Illinois Engineering Co., Chicago. A ¾-in. No. 35 Eclipse steam trap in operation also, other steam and vapor specialties. Representatives, Walter Dickson, A. L. Browne, J. C. Matchett, J. L. Ehretsman.

Booth 233—Gibby Engineering Co., East Boston, Mass. Hand stokers.

Booths 234-235—Air Preheater Corp., New York City. Lunjstrom air preheater and forced-draft systems, also a demonstration of regenerative system of air heating.

Booth 236—Wright-Austin Co., Detroit, Mich. Line of steam specialties including weighted trycocks and water gage with glass replacing union. Safety alarm water columns and chain pull gages and try cocks.

Booths 237-240—Merrick Scale Mfg. Co., Passaic, N. J. Merrick mechanical weightometer in operation.

Booths 241-242—Chas. Cory & Sons, Inc., New York City. Signaling, communicating, lighting, control and protective devices, including turbine signals, load indicators, time clocks, pressure gages, switchboards, valve operators, door operator systems, mechanical and electrical interlocks and fire detecting equipment, also flexible metal hose. Representatives, J. S. Jones, L. E. Oneal, A. D. Blanchard, G. B. Thieme, M. I. Warshow, J. B. Feder, A. A. Kopp, R. L. Reaves, H. D'Almaine, A. E. Sargent, C. C. Lamb, W. B. Tardy.

Booth 243—John R. Robinson, New York City. Pipe gaskets.

Booths 244-245 — Blackburn-Smith Corp., New York City. Feed-water filter and grease extractor. Multiduct strainers for water and oil. Automatic primers for centrifugal pumps.

Booth 244—Automatic Primer Co., Chicago, Ill. "Apco" primer for centrifugal pumps. A centrifugal pump equipped with primer and float switch will be shown.

Booth 244—Sherwood Mfg. Co., Buffalo, N. Y. Force-feed oil pumps in single- and multiple-feed types.

Booth 246—Fafnir Bearing Co., New Britain, Conn. Complete line of standard ball bearings in single- and double-row types, and radial thrust bearings, also hanger boxes, pillow blocks, loose pulley, etc.

Booth 247—Bradley Wash Fountain Co., Milwaukee, Wis. Wash fountains.

Booth 248—The Dempney Co. of America, Boston. Apexior protective coatings for preventing corrosion on boilers, economizers, heaters, etc., and a power brush for applying the coatings.

Booth 249—The Whitney Mfg. Co., Hartford, Conn. Double bearing pin and bushing, rolling joint and standard steel roller chain for power transmission. Representatives, C. E. Wertman, D. I. Wheeler, R. A. Glass, R. J. Howison.

Booths 250-251 — Walsh - Weidner Boiler Co. Seamless forged steel sectional headers as used in its water-tube boiler, photographs of installations and other constructional features.

Booths 252-253 — The Fulton Co., Knoxville, Tenn. "Sylphon" pressure and temperature regulators, thermostatic water mixer, interlocking valve for fuel-oil systems and liquid transmission regitherm.

Booth 254—Joseph Dixon Crucible Co., Jersey City. Flake graphite, graphite greases, silica-graphite paint, aluminum - graphite paint and other graphite products. Representatives, J. M. Willits, C. McNaughton, O. D. Shonnard, C. A. Williamson, J. A. Caldwell, H. Rogan, George I. Drayton.

Booth 255—Merco Nordstrom Valve Co., Inc., New York City. Line of lubricated plug valves, a 12-in. plug valve equipped for worm-gear operation, a plug valve designed especially for steam service with new type stem packing and mechanical means of lifting the plug from its seat and reseating it. Also a demonstration with pressure and micrometer gages showing the pressure it is possible to put beneath the plug of the valve.

Booths 256-257—The Moto-Meter Co., Inc., Long Island City, N. Y. Motoco industrial thermometers.

Booth 258—Gritanner Engineering Corp., New York City. Steam-jet and hydraulic ash conveyors, soot and fly-ash removal systems. A miniature model of the ash conveyor will be in operation.

Booth 259—X Laboratories, New York City. X Liquid for repairing leaks in boilers, etc.

Booth 260—The S. Obermayer Co., Newark, N. J. High-temperature cements and monolithic firebrick material. Representatives, H. E. Beckman, E. D. Frohman, J. L. Cummings, and T. P. Bullion.

Booths 262-263 — Morse Chain Co., Ithaca, N. Y. Silent chains of different sizes in operation. Rocker-joint construction of the chain will be featured.

Booth 264—Carrick Engineering Co., Chicago, Ill. Automatic combustion control equipment, also chronometer valves.

Booths 265-266 — Techno Service Corp., New York City. Borsig 8-in. swing-type gate valve for 400 lb. pressure and 750 deg. temperature motor operated. Samples of welding on pressure tanks for high pressures and temperatures. Brinell portable meter, Technical clock movements, hydraulic machinery for various pressures.

Booth 267—G. M. Davis Regulator Co., Chicago, Ill. Aluminum models of pressure regulator, back-pressure valve, steam trap, float valve, balanced valve, and stop and check valve. Also model of a wing disk type of check valve, especially adapted for use on turbine bleeder lines, atmospheric relief valve and a resistance valve for air and gas compressor lines. Representatives, George C. Davis and H. A. Freeman.

Booth 268—Midwest Piping & Supply Co., St. Louis, Mo. Midwest joints for superheated steam at pressures of 900 lb. and temperatures to 750 deg. A midwest joint deflected 3 per cent and under a pressure of 2,000 lb. A modification of the joint for high-pressure drip and drain lines. Also sample of pipe bends with short radius.

Booth 269-270—Henry Vogt Machine Co., Louisville, Ky. Drop-forged steel valves and fittings for high pressures.

Booths 271-272-273—Elliott Co., Jeanette, Pa. A 100-kw. geared turbine generator unit, consisting of a Kerr turbine and reduction gear and a Ridgway generator.

Booth 272—The Lagonda Mfg. Co., Springfield, Ohio. Boiler-tube cleaners, tube cutters and reseating machines.

Booth 273—Liberty Mfg. Co., Pittsburgh, Pa. Boiler-tube cleaners.

Booth 274—Barrett Machine Co., Pittsburgh, Pa. Wrenches and jacks.

Booth 274—Chicago-Wilcox Mfg. Co., Chicago. Wilcox metallic pipe gaskets.

Booth 274—Advance Engineering Co., New York City. Products of the A. W. Cash Co. and the Armstrong Machine Works.

Booth 275 — Armstrong Machine Works, Three Rivers, Mich. Standard line of Armstrong traps, also steel traps for high pressure and superheat and a compound trap for handling large flows of condensate. A glass model will be in operation to show the cycle of operation.

Booth 276—A. W. Cash Co., Decatur, Ill. Reducing valves, auxiliary control regulators, pump governor, strainers and relief valves.

Booth 277—Builders Iron Foundry, Providence, R. I. Venturi meter equipment for the measurement of feed water, turbine condensate, cooling water, evaporator discharge, etc. The meter will be of the registering, indicating and recording type. In addition a cast-steel venturi meter tube for 1,000 lb. pressure, a cast-iron tube for low pressure, indicating barometric monometers and a special radial planimeter for obtaining totals from venturi charts will also be shown. A recorder will be piped to a small venturi tube to show a meter in actual operation. Representatives, D. J. Purdie, E. S. Smith, A. A. Wood, A. E. Watjen, F. A. Merle and H. J. Leonard.

Booth 278—Ilg. Electric Ventilating Co., Chicago, Ill. A 50-in. multiblade blower direct connected to a variable-speed motor, which is held in a retaining ring directly to the blower side. A factory unit heater equipped with electric heating coils and a motor propeller fan fitted with two-speed controller. Also a portable floor fan of 10,000-cu.ft. capacity for man cooling in foundry, etc., and for drying and cooling various materials.

Booths 279-280 — Norma - Hoffman Bearing Corp., Stamford, Conn. Complete line of ball, roller and thrust bearings. Several models illustrating the proper method of applying ball bearing in power transmission machinery. Also, an instrument illustrating the amount of creep that takes place in a bearing where the outer ring is held stationary and the inner ring revolving, also the creep when the inner ring is held stationary and the outer ring permitted to revolve.

Booths 281-282—L. L. Smidth & Co., Inc., New York City. Lenix short-center belt drive with a demonstration of the power lost through belt slip and the action of the Lenix drive in preventing slip.

Booths 283-284 — Richardson Scale Co., Clifton, N. J. Apron-feed coal scales and hand weighing lorry.

Booth 285—The Wickes Boiler Co., Saginaw, Mich. Views of boilers in process of construction and actual installations of the various types.

Booths 286-287 — Pennsylvania Crusher Co., Philadelphia, Pa. Working models of Bradford coal breaker and armoframe coal crushers.

Booths 288-289-290—Edge Moor Iron Co., Edge Moor, Del. Sections and photograph of box-header type boilers for pressures of 350, 385, 425 lb. Also photograph of a low-pressure heating boiler of the cross-drum, horizontal-tube type especially designed for low headroom.

Booths 292-293—Ramsey Chain Co., Inc., Albany, N. Y. Ramsey silent chain drives.

Booths 296-297 — Wailes Dove-Hermiston Corp., New York City. Paints and enamels for metal surfaces.

Booth 300—Murray Conduit System, New York City. Apparatus for the construction of monolithic duct banks, also section of actual duct banks.

Booth 301—Thomas E. Murray, Inc., New York City. Photographs and cross-section drawings of power plants designed and installed by this company.

Booths 302-303 — Centrifix Corp., Cleveland, Ohio. Line of centrifugal separators for steam, air, liquids, etc.

Booths 304-305—Preferred Utilities Co., Inc., New York City. "Ray" rotary fuel-oil burner, an electrically driven fuel-oil burner with steam-actuated oil and air controls, also various sizes of the small Ray automatic fuel-oil burner.

Booths 306-307—Pyramid Iron Products Corp., New York City. Pyramid grates and details of settings.

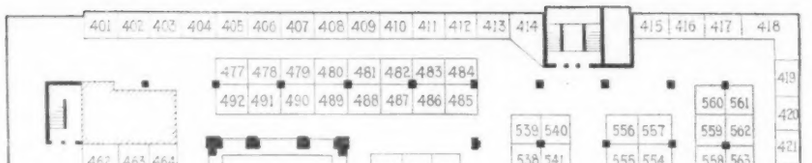
Booths 308-309-310-311 — Walworth Co., Boston, Mass. Valves, fittings and specialties.

Booths 312-313 — Barnes & Jones, Boston, Mass. Modulation, vapor and vacuum heating systems, thermostatic radiator, vacuum return, blast, vent and boiler return traps, modulation steam and water valves.

Booths 314-315—Johns-Manville, Inc., New York City. Raw asbestos and the processes by which it is converted into the various products including packings, insulating materials, roofing, etc.

Booth 316 — Continental Valve & Equipment Co., Framingham, Mass. Forged-steel pipe fittings, screw-end forged steel unions, flanged unions pump governors, reducing valves, and unions for refrigeration service.

Booth 317—Klingerit Inc., New York City. Valves, packings and gage glasses for high pressures.



A Trip to the Third Floor

Booth 318—Tinius Olsen Testing Machine Co., Philadelphia. Production type Brinell hardness tester with motor drive, ductility testing machine with strain gage weighing system, etc. Representatives: T. Y. Olsen, R. B. Lewis and J. Lundgren.

Booths 319-320—Aero Pulverizer Co., New York City. Aero unit coal pulverizer and burning equipment.

Booths 321-322 — American Blower Co., Detroit, Mich. Fans, blowers, air conditioning equipment and dry-air filters.

Booths 323-324-325—Norton Co., Worcester Mass. Complete line of silicon-carbide boiler furnace refractories and cements, including a section of crystolon bricks at the clinker line. Representatives: H. B. Lindsay, F. E. Leiby, C. W. Saxe and R. K. Kirkpatrick.

Booths 326-331—Fairbanks-Morse & Co., Chicago. Ball-bearing centrifugal pumps and motors, reciprocating pumps and Diesel engines.

Booths 332-333 — S.K.F. Industries, Inc., New York City. S.K.F. ball bearings, including radial and thrust single and double, bearing hangers and pillow blocks.

Booths 334-335—Schutte & Koerting Co., Philadelphia, Pa. Double-duty boiler feed injectors, reducing valves, multi-jet condensers, radia-fin tube generator air cooler. Spur and herringbone rotary gear pumps, and "Klinger" piston valves. Representatives: H. W. Philbrook, C. T. Keet and G. Heinemann.

Booth 336—Standard Steel & Bearings, Inc., Plainville, Conn. Annular single- and double-row ball bearings and ball thrust bearings.

Booth 337—Hardinge Co., York, Pa. Working models of the Hardinge conical mill and the reverse-current classifier, also a super-thickener and clarifier. Representative; W. H. Withington.

Booth 337—Ruggles Coles Engineering Co., New York City. Cylindrical driers for coal and other materials.

Booth 337—Steacy-Schmidt Mfg. Co., York, Pa. Steam specialties.

Booth 338-339—The Falk Corp., Milwaukee, Wis. Type "D" herringbone gear speed reducers and type "C" flexible couplings.

Booths 340-341-342—Boston Gear Works Sales Co., Norfolk Downs, Mass. Speed reduction units, silent chain drives and spur gears.

Booth 341—Hans-Renolds Co., New York City. Silent chain drives.

Booth 341—Nice Ball Bearing Co., Philadelphia, Pa. Complete line of single and double annular ball bearings, combination type radial and thrust ball bearings and pressed-steel ball-bearing casters.

Booth 343 — Marlin-Rockwell Corp., Jamestown, N. Y. Complete line of Gurney ball bearings.

Booths 344-345 — Bartlett-Hayward Co., Baltimore, Md. "Fast's" standard and special flexible couplings for various services.

Booths 346-347—The Bayer Co., St. Louis, Mo. Soot blower for all types of boilers including a valve-in-head blower model K-2 with a special attachment to the blower head for providing air circulation through the element when not in use. Representatives: F. B. Rose and L. J. Bayer.

Booths 401-402 — McClave-Brooks Co., Scranton, Pa. Shaking and dumping grates and chain-grate stokers for small-sized anthracite and bituminous coal.

Booths 403-404—Johnson Service Co., Milwaukee. Heat-regulating devices.

Booth 405—Peerless Machine Co., Racine, Wis. A motor-driven universal shaping saw and a 6-56. Peerless high-speed metal saw.

Booth 406—Thomas Flexible Coupling Co., Warren, Pa. Flexible shaft couplings.

Booths 407-408—Mueller Brass Co., Port Huron, Mich. Brass and copper products in the form of rod, tube, forgings, castings and screw-machine parts.

Booths 409-410—Coffin Valve Co., Boston, Mass. Gate valve equipped with a Kelty motor-drive unit, hydraulically operated pivot valve with automatic solenoid-operated control valve, also a solenoid-operated valve for remotely controlling the operation of an hydraulic cylinder.

Booths 411-412-413-414—B. F. Sturtevant Co., Boston, Mass. A new type induced-shaft fan in which is incorporated a number of special features. A tubular air heater with lead coated surfaces, plate type air heater. Turbovane forced-draft fan, and turbo undergrate blowers.

Booths 415-416—Davis Engineering Co., New York City. Paracoil steam traps, feed-water heaters, feed-water filters, grease extractors and evaporators.

Booths 417-418-419—Smoot Engineering Corp., New York City. Smoot centralized system of combustion control in operation. The system consists of a master controller and regulator which automatically control the input of fuel aid air.

Booths 420-421—Pittsburgh Piping & Equipment Co. Valves and samples of piping for high pressures and temperatures. Samples of wrought-steel welded headers, with welded-in nozzles and sargol weld joint.

Booth 422—Alexander Brothers, Philadelphia, Pa. Tentacular leather belting.

Booth 423 — Ackerman-Johnson Co., Chicago, Ill. Expansion bolts and hangers.

Booths 424-425-426-427 — American Machine & Fdry Co., Brooklyn, N. Y. Apron feed and automatic sacking scales, rotary high-speed direct-drive pumps. Representatives: R. E. Wells, D. M. Linche, T. F. Dupuy, T. R. Stevens, H. Woodall, William Cooper, William McKelvie, C. O. Wright, Jr.

Booth 424—Automatic Weighing Machine Co., Newark, N. J.

Booth 425 — Wahlstrom Tool Co., Brooklyn, N. Y. Automatic chucks, tapping attachments and a safety tapping chuck.

Booth 428 — Homestead Valve Mfg. Co,. Homestead, Pa. Standard line of Homestead products including quarter-turn valves, three- and four-way lubricated plug valves, globe valves, combination blowoff valves and protected-seat hydraulic operating valves.

Booth 429—A. M. Byers Co., Pittsburgh, Pa. Samples of Byers wrought-iron pipe.

Booth 430 — Oxweld Acetylene Co., New York City. Oxweld cutting and welding equipment, stationary and portable acetylene generators, welding rods and fluxes.

Booth 430—Linde Air Products Co., New York City. Welding apparatus and supplies.

Booth 431—Hendrick Mfg. Co., Carbondale, Pa. Perforated metal screens, elevator buckets, interlocked steel grating and spur-site stair treads.

Booths 432-433-434 — The Leeds & Northrup Co., Philadelphia, Pa. Electric CO_2 recorders, electric flow-meter designed to obviate inaccuracy from lead and contact resistances or line voltage variations; generator-field temperature recorder with automatic alarm contact, frequency recorder, direct-reading B.t.u. recorder for measuring and recording automatically the heat of boiler feed water, remote station load

A special feature will be a complete working demonstration of a combustion control for both powdered-coal and stoker-fired furnaces. Representatives: W. M. Stein, L. O. Heath, R. C. Cleeland, D. E. Mont, J. H. Hayner, E. S. Bristol, P. A. Newman.

Booth 435—Liberty Electric Corp., Stamford, Conn. A Liberty valve operator on a 6-in., 600-lb. gate valve showing operation from push-button local and remote stations. This unit will demonstrate the actual functioning of the safety clutch, which is designed to prevent the breakage of valve stems or other damage to the valve. A cut-out control showing the principle of operation will also be on exhibit. Representatives: M. Cronkite, P. W. Bliss, C. A. Craig, Jos. McKay, Jr., E. J. Panish, G. A. Mowbray.

Booth 436—E. B. Badger & Sons Co., Boston, Mass. Expansion joints and spray nozzles.

Booth 437—Insulating Products Corp., New York City. Heat insulating products for various services.

Booths 438-439—Irving Iron Works Co., Long Island City, N. Y. Irving subway flooring and vizabledg safstep.

Booth 440—Eastern Steam Specialty Co., New York City. Steam specialties.

Booth 440 — Instant Water Heater Sales Division, Chicago, Ill. Cut-out section of an instant type copper-tube steam water heater, and a complete heater and economizer installation.

Booth 441—Harms & Co., Brooklyn, N. Y.

Booth 442—Welding Engineer, Chicago, Ill.

Booth 443—Chicago Pipethread Mach. Co., Racine, Wis. Power pipe-threading machines.

Booth 444 — International Trade Press. New York City.

Booth 445 — Locke Regulator Co., Salem, Mass. Damper regulators, balanced valves, pump governors, reducing valves and engine stops.

Booths 446-447—Sterling Engine Co., Buffalo, N. Y. Commercial type engines for driving pumps, generators, etc. The engines are equipped with counterweighted crankshafts dynamically balanced.

Booth 448—Midwest Air Filters, Inc., Bradford, Pa. Sections of air filter with washing and dipping equipment.

Booth 449 — Snap-on Wrench Co., Chicago, Ill. Wrenches and tools.

Booth 449—Motor Tool Specialty Co., Chicago, Ill. Motor-driven tools.

Booth 450—Boiler Engineering Co., Newark, N. J. "Beco" baffle wall construction.

Booth 451—Pitts & Kitts Mfg. & Supply Co., New York City. High- and low-pressure steam traps, feedwater and damper regulators, reducing valves, safety water columns, gage cocks, etc.

Booths 452-453—The Spencer Turbine Co., Hartford, Conn. Centrifugal compressor for supplying air at 1 to 3 lb. pressure for use with oil and gas burning industrial furnaces, foundry cupolas, etc. Also vacuum cleaning apparatus for industrial purposes. Representatives: I. H. Spencer, L. E. Phillips, E. J. Skillman, F. Martin, F. A. Wright, V. J. Dingee.

Booth 454—The Foundation Co., New York City.

Booth 455—Horsburgh & Scott Co., Cleveland, Ohio. Full line of worm-gear speed reducers, also a recent development in cutting an exceptionally low ratio worm and gear job.

Booth 456—Kieley & Mueller Co., New York City. Steam specialties including back-pressure, atmospheric-relief, reducing, stop and check valves, also an air eliminator for vapor heating systems and a steam trap for 400 lb. pressure.

Booths 457-458—Niles Gear Co., New York City. Samples of various types of gears including spur, single helical and herringbone types.

Booth 459—The Borden Co., Warren, Ohio. Easy working die stocks, square end pipe cutters and power drive for hand tools.

Booth 460—Flexible Steel Lacing Co., Chicago. Alligator steel belt lacing, belt fasteners and expanded steel guards for electric lamps.

Booth 461—Standard Turbine Corp., Scio, N. Y. Small turbo-generator set for emergency lighting, exciter units, etc. Also a two-stage turbine for horsepower up to 300 non-condensing equipped with needle-valve-controlled nozzles making the machine adaptable to all loads and any steam conditions. Turbine is also equipped with non-corrosive and non-errosive blading and nozzles, forged-steel disks, ball bearing fulcrum point governors and pedestal supported bearings.

Booth 462—Ajax Flexible Coupling Co., Westfield, N. Y. Flexible shaft couplings.

Booth 463—Consolidated Coal Co., New York City.

Booth 464—W. A. Jones Foundry & Machine Co., Chicago, Ill. Spur- and worm-gear speed reducers, miscellaneous power-transmission appliances.

Booth 465—Accurate Brass Casting Co., Inc., Brooklyn, N. Y. Copper and brass castings and forging made to close dimensions.

Booth 466—Reed Air Filter Co., Inc., Louisville, Ky. Reed self-cleaning air filter, the arrangement of the parts, the filter, the distributor and the oil cleaner will be demonstrated.

Booth 467—Poole Engineering & Machine Co., Baltimore, Md. Poole flexible gear-type coupling and speed reduction units.

Booths 468-469—Clarage Fan Co., Kalamazoo, Mich. Air washers, fan for heating and ventilating, high-speed fan for forced and induced draft, exhauster for pneumatic conveying and material handling. Vertical type-V steam engine, blast gates, including the half-round, standard and extra-heavy flanged gate; crown ventilator and formed sheet-metal doors will be on exhibition.

Booth 470—Industries of America, Inc., New York City.

Booth 471—The D. E. Whiton Machine Co., New London, Conn. Four sizes of Lee steam turbines with one open for inspection, Lee Boiler feeder consisting of turbine and centrifugal pump, the turbine being equipped with "follow-up" governor, emergency-overspeed and no-water stop. Parts of the turbine such as nozzles, chambers packing, etc., will be shown.

Booth 472—Curtis & Curtis Co., Bridgeport, Conn. A direct-connected motor-driven pipe cutting and threading machine equipped with self-centering vise and automatic operating die release and cutting-off tool.

Booth 473—Automatic Electric Co., Chicago, Ill. Automatic electrical control for power plant and industrial machinery.

Booth 474—Air Reduction Sales Co., New York City. Oxygen and acetylene in cylinders, hand welding and cutting apparatus and supplies, such as welding rods, fluxes, gages, etc. Representatives: W. S. Schoenthaler, F. Morton, B. F. Shaeffer, W. I. Lebaugh, E. S. Grace, H. G. Fay, and G. Van Alstyne.

Booth 475—*New York Commercial.*

Booth 476—The Unishear Co., Inc., New York City. Several models of unishears one having a capacity of cutting flat stock up to and including ¾-in. cold rolled steel.

Booth 477—Sweet & Doyle Foundry & Machine Co., Troy, N. Y. An 18x36-in. heat-treating furnace, several sizes of power gas burners and a 2,000-ft. capacity air gas proportional control valve; a control valve operating one of the small-sized gas burners will be shown in operation.

Booths 478-479—Dodge Mfg. Co., Mishawaka, Ind. Complete line of power-transmission equipment including roller-bearing shafting hangers, pillow blocks, split pulleys and friction clutches.

Booths 480-481—Bassick Mfg. Co., Chicago, Ill. Complete line of Alemite-Zerk apparatus for conveying lubricant from the original container to the bearings without the lubricant being exposed. Also, a 25-lb. compressor that operates with air.

Booth 482—S. Fabian Goodman, New York City. Annular single- and double-row ball bearings, roller bearings and steel balls.

Booths 483-484—A. Allen & Sons, Harrison, N. J. Several applications of Allen red metal including labyrinth packing rings for steam turbines; metal piston-rod and valve-stem packing rings for locomotives, marine and stationary engines; metal-faced pistons for steam engines, air compressors and pumps.

Booths 485-486—Wilson Welder & Metals Co., Hoboken, N. J. Gasoline-engine-driven electric welding machine.

Booths 487-488-489 — Westinghouse Electric & Manufacturing Co., Pittsburg, Pa. A 7½ kw. turbo-generator unit a 150-kw. geared turbine generator unit and "Micarta" gears.

Booth 490—Ruths Accumulator Co., Inc., New York City. Photographs of accumulator systems also important parts, such as steam governors and controls.

Booths 491-492—Allen & Billmyre Co., Inc., New York City. A 10-hp. heavy-duty pneumatic sweeping systems for use in power plants, dust collectors with special dumping bottoms, a 5-hp. blower for numerous purposes, pneumatic tube systems, a 5-hp. portable pneumatic sweeping unit for industrial plants, and a ½- and ¾-hp. portable unit for general cleaning.

Booths 493-494—Durable Mfg. Co., New York City. Compressed asbestos fiber sheet and semi-metallic rod pack-

ing, high-pressure gage glasses, valve disks and metal pump valves.

Booth 495—The Wm. Powell Co., Cincinnati, Ohio. Complete line of bronze, iron, steel, globe angle, check, gate and safety valves, oilers, lubricators, water gages, fusible plugs, etc. Also a 12-in. 400-lb. steel gate valve for 750-deg. temp. equipped with motor control. Representatives: James Coombe, W. Heilig, C. Kemmeron and C. Dom.

Booth 496—B. F. Shaw Co., Wilmington, Del. Belt-turned and recessed joint pipe.

Booths 497-498—Hyatt Roller Bearing Co., Newark, N. J. Roller bearings for all kinds of transmission equipment.

Booth 499—Racine Tool & Machine Co., Racine, Wis. High-speed metal cutting machine, duplex band-saw machine and shear-cut production saw.

Booth 500—Strong-Scott Mfg. Co., Minneapolis, Minn. A quarter-scale working model of a 3,000-lb. capacity "Unpulvo" coal pulverizer and burner. A working model of a coal drier built entirely of cast-iron sections.

Booth 501—The Frederick Iron & Steel Co., Frederick, Md. A double-suction single-stage centrifugal pump and a 2-in. four-stage boiler feed pump with hydraulic balancing feature, a 1-in. pump in operation equipped with a glass window to show the discharge of the liquid from the periphery of the impeller. Representatives: G. R. Hargis, J. T. Norman, O. C. Lease and R. H. McCain.

Booth 501—Anton Flettner, New York City. Models, photographs and descriptions of the Flettner rotorship, rotor ventilator, rudder and windmill.

Booth 502—M. A. Hofft Co., Indianapolis, Ind. National hand stoker and furnace arch, also moving picture showing arch under repair.

Booth 503—Drying Systems, Inc., Chicago, Ill. Air filtering equipment.

Booth 504—The Casey-Hedges Co., Chattanooga, Tenn. A working model of the multi-pass boiler and large photographs of various type of boilers manufactured by the company.

Booth 505—The Garlock Packing Co., Palmyra, N. Y. Types of mechanical packing made of asbestos, rubber, fibrous materials and also of metal.

Booth 506—International Steam Engineer, Chicago, Ill.

Booth 507—Taylor Instrument Companies, Rochester, N. Y. Industrial thermometers of different types, single and bi-record recording thermometers, self-acting and air-operated temperature controls for use on desuperheaters, bleeders lines, etc., indicating and recording thermoelectric pyrometers, aneroid and mercurial barometers, mercury column, vacuum and absolute pressure gages, distance-reading electric transmitting thermometers and direct-reading superheat thermometers.

Booths 508-509—Moore Steam Turbine Corp., Wellsville, N. Y. A 4-in. four-stage double-suction boiler-feed pump driven by a multi-stage steam turbine; also an oil relay governor as used on the larger Moore turbines, in operation to demonstrate the principle of operation.

Booths 510-511—Weston Electrical Instrument Co., Newark, N. J. Switchboard rectangular meters, speed indicators and portable precision instruments. Representatives: J. W. Dowden, L. C. Nichols and C. B. Denton.

Booth 514—Rollway Bearing Co., Syracuse, N. Y. Line of radial and thrust roller bearings for heavy-duty equipment, also bearing housing for standard type of electric motors.

Booth 515—American Hoist & Derrick Co., St. Paul, Minn. Features of the American steam, gasoline and electric hoists, locomotive cranes, power shovels, etc., for the handling and reclaiming of coal will be demonstrated.

Booths 516-517-518—Allis-Chalmers Mfg. Co., Milwaukee, Wis. Reyrolle armor-clad switch gear in operation. This gear combines in one factory built unit the bus structure, circuit breaker, outgoing feeder connections and instrument transformers. The exhibit will also include induction motors equipped with roller bearings, inclosed self-ventilating motors, applications of the texrope drive, a 5-in. centrifugal pumping unit sectionalized to show construction of pump and motor. Hydraulic turbine runners of various types with models of some of the larger wheels. Representatives: A. F. Rolf, H. W. Dennison, A. J. Cooper, H. C. Hall, F. I. Geiger, R. H. James, C. A. Pihl, G. Baiz, W. O. Taylor, S. Larios, L. M. Littman, D. M. Weller and F. M. Decker.

Booth 519—John Simmons Co., New York City. Valves and fittings.

Booths 520-521—Sauerman Bros., Inc., Chicago, Ill.

Booth 522—Pennsylvania Pump & Compressor Co., Easton, Pa. A 6x5-in. straight-line air compressor motor-driven, working model of air-lift pump and a 3-in. six-stage high-pressure boiler feed pump.

Booth 523—Cooling Tower Co., New York City. Impact air washers, air filters and spray nozzles; also photographs of cooling towers and spray nozzles cooling systems.

Booths 524 to 528—Topping Bros., New York City. Products of the manufacturers which they represent.

Booths 524-525—Bearium Bearings Inc., New York City. Rough and machined bearings for all types of services. The non-scoring, non-seizing emergency feature of the metal will be demonstrated. Representatives: H. G. Pagasai, W. H. Judy, F. A. Robertson, A. A. Mathews, J. W. Haig and H. R. Johnson.

Booth 525—Whitman-Barnes-Detroit Corp., Detroit, Mich. Drills and chucks.

Booth 526—Torchweld Equipment Co., Chicago, Ill. Complete line of oxyacetylene equipment consisting of gas cutting and welding equipment, gas pressure regulators and gas welding supplies. Representative: W. A. Slack, R. J. Petty and E. W. Gardner.

Booth 527—Templeton-Kenly Co., Chicago, Ill. Simplex jacks.

Booth 528—Ames Shovel & Tool Co., Boston, Mass. Tools and specialties will be exhibited.

Booth 529—T. B. Wood's Sons Co., Chambersburg, Pa. Line of power transmission appliances including automatic belt contactors, flexible couplings and ball-bearing hanger boxes. Representatives: C. O. Wood, W. H. Fisher, T. B. Wood, G. H. Wood, C. E. Bailey and G. R. Washinger.

Booth 530—General Refractories Co., New York City. Various classes of refractories including sized fire brick and high-temperature cement.

Booths 531-532 — Manistee Iron Works Co., Manistee, Mich. Rees Roturbo centrifugal pumps including one of the multi-stage horizontally split type and a single-stage horizontal volute pump. An impeller will also be shown.

Booth 533—Spray Engineering Co., Boston, Mass. Spraco air cooler and washers. Air filters, strainers and jet nozzles.

Booth 534—Strom Ball Bearing Mfg. Co., Chicago, Ill. Radial single- and double-row, angular contact, thrust and adapter type ball bearings.

Booths 535-544—Federal Gage Co., New York City. Indicating and recording gages for pressure and vacuum also "mercoid" switches for various uses in controlling pressures and temperatures.

Booth 536—De Laval Steam Turbine Co., Trenton, N. J. A working exhibit of worm-reduction gear drives, including horizontal and vertical gears in single and double reduction, heavy-duty gears with positive pump lubrication, a complete motor-driven pump-testing unit with all the auxiliaries, including venturi tube, tanks, piping gages, etc., A line of pin and rubber bushing type flexible couplings, a velocity-stage turbine in sections. A complete turbine rotor for a multi-stage machine, and in addition a turbine wheel forging.

Booths 536-543—De Laval Separator Co., New York City. Complete line of oil purifiers for lubricating oil and transformer oil, also a crankcase oil reclaiming outfit.

Booth 545—Barco Mfg. Co., Chicago, Ill. Flexible joints and lubricated plug valves.

Booth 546—Botfield Refractories Co., Philadelphia. Adamant firebrick cement. An overhung arch will be shown to demonstrate the holding properties of this cement.

Booths 547-548—American Pulley Co., Philadelphia, Pa. Standard line of pressed-steel split pulley and shaft hangers.

Booth 549—Roberts Steam Specialty Co., Cleveland, Ohio. Forged-steel water columns seamless copper and laminated steel floats, water-column adapter for changing a vertical glass to an inclined position, gage light and weighted-lever gage locks.

Booth 550—Foote Bros. Gear & Machine Co., Chicago, Ill. Spur-, worm-, and herringbone-gear speed reduction units, a combination unit consisting of a spur and worm reducer giving a reduction ratio of 3,600 to 1.

Booth 551—Clipper Belt Lacer Co., Grand Rapids, Mich. Complete line of Clipper belt lacers.

Booths 552-553—Atwood & Morrill Co., Salem, Mass. Atmospheric relief valves, reverse current valves, adjustable combustion regulator and damper controls.

Booths 554-555-556-557 — Ingersoll-Rand Co., New York. Complete line of Cameron pumps including a class "HMT" high-pressure multi-stage centrifugal boiler feed pump built for pressures up to 1,500 lb. and equipped with a hydraulic balancing drum to neu-

tralize the thrust and eliminate high pressure on the stuffing box. A class "HW" hotwell and condensate pumps of the horizontal volute type employing two single-suction inclosed impellers with opposed inlets. In addition enlarged diagrammatic charts will be on exhibit to show the features of the Ingersoll-Rand surface condenser having a separate compartment for cooling the air and non-condensable vapors.

Booths 558-559-560—Ruggles-Klingemann Mfg. Co., Salem, Mass. Step-action regulators, pressure regulators and motor-operated regulators for control of pressures and temperatures.

Booths 561-562—National Acme Co., Cleveland, Ohio. Grindley automatic turret lathe and a high-speed Acme automatic screw machine.

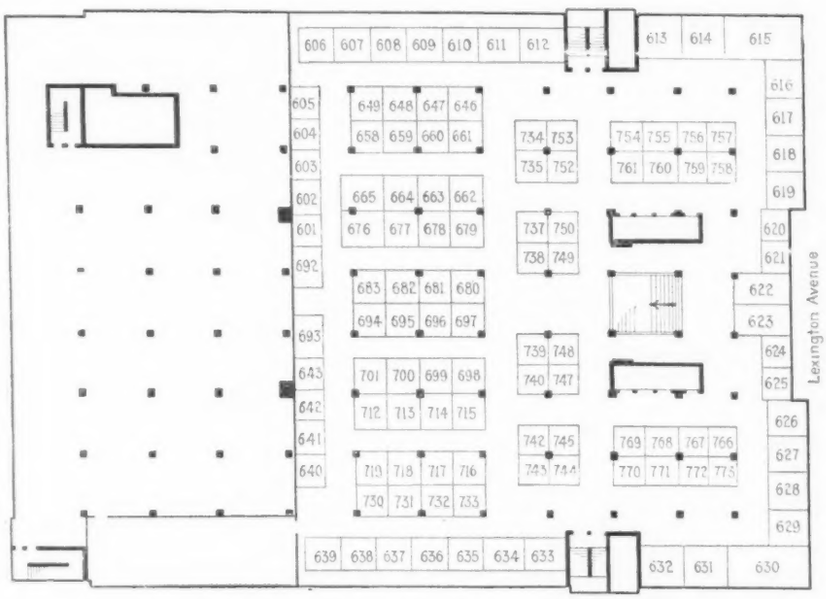
Booth 563—M. B. Skinner Co., Chicago, Ill. Working exhibit of the Skinner combined reseating tool, and high-pressure saddle clamps.

Booth 564—Andale Engineering Co., Philadelphia, Pa. Single and duplex strainers, grease extractors and heat exchanges.

Booths 565-566-567 — Worthington Pump & Machinery Corp., New York City. Type L. centrifugal pump with horizontal split casing and double-suction inclosed-type impeller, a multi-stage hydraulically boiler feed pump of the volute type designed for 425 ft. head, "Axiflo" sump pump and two vertical and two horizontal single-stage compressors.

Booth 568—The Leavitt Machine Co., Orange, Mass. Dexter globe, gate, and pump valve-reseating outfits.

Booth 569—Queen's Run Refractories Co., Inc., Lock Haven, Pa. Standard shape brick for lining boiler furnaces, special roof and bung brick for heating and reverberatory furnaces. Number of intricate special shapes for furnace repairing.



Exhibits on the Fourth Floor

Booth 605 — American Abrasive Metals Co., New York City. Floor plates and stair treads.

Booth 610—Gits Bros. Mfg. Co., Chicago, Ill. Complete line of oil cups, oil-hole covers, gravity and capillary attraction wick-feed oilers.

Booth 611—Charles Engelhard, Inc., New York City. Indicating and recording pyrometers, gas analyzers thermocouples, and electric-resistance thermometers.

Booth 612—Ogilvie Bros., Ltd., Ottawa, Canada.

Booth 615 — American Engineering Standards Committee, New York City.

Booth 616 — American Society of Heating and Ventilating Engineers, New York City.

Booth 617—American Pulverizers Co., St. Louis, Mo. Ring coal crushers and pulverizers.

Booth 618—International Correspondence School, New York City.

Booth 619—LaMont Corp., New York City. New-type steam generator employing small tubes (2-in.) and forced circulation.

Booths 620-621—The Reliance Elec. & Engrg. Co., Cleveland, Ohio. A water- and dust-tight direct-current motor for driving stokers and other equipment subject to coal dust, bad steam and water conditions, an alternating-current motor with stator insulated to give protection against acids, dirt, steam and water conditions, also standard sleeve- and ball-bearing motors.

Booths 622-623—Yale & Towne Mfg. Co., Stamford, Conn. Ball-bearing chain blocks in sizes from ½ to 20 ton capacity, screwed geared chain blocks, differential chain blocks, ball-bearing electric chain hoists for push button or manual control, hoist trolleys and crane beams.

Booth 624 — Power Age, Toronto, Canada.

Booth 625—M. Katzenstein & Son, Brooklyn, N. Y. Wiping and polishing cloths and waste.

Booth 626—Henry Pels & Co., New York City. Triple combined punch and shear.

Booth 627—The Korfund Co., New York City. Natural grown cork plates for isolating machinery from the foundation. Special apparatus for the absorption of vibration will also be shown in connection with a 1-ton ammonia compressor.

Booth 628—W. A. Marshall & Co., New York City.

Booth 681—Combustion Service Corp., New York City.

Booth 632 — Research Engineering Corp., New York City.

Booths 633-634—Hoffman Specialty Co., Inc., Waterbury, Conn. Hoffman specialties, including air valves and heat-control apparatus.

Booth 634—Vulcan Electric Brazer & Welder Co., Paterson, N. J. Electric brazing and welding apparatus.

Booth 635—Atlas Valve Co., Newark, N. J. Campbell feed-water regulator. A small boiler will be in operation to show the operating features of this regulator.

Booth 640—Walls Sales Corp., New York City. Tool grinders and specialties.

Booth 640—Benjamin E. Jarvis, Inc., New York City.

Booth 641—Hutchinson Mfg. Co., Inc., New York City. Woodworking machinery and tools.

Booth 643—Combustion Sales Co., New York.

Booths 646-647-661—Triplex Machine Tool Co., New York City. Products of the Ex-Cell-O Tool & Mfg. Co. and of the B. C. Ames Co.

Booth 646—B. C. Ames Co., Waltham, Mass. Bench lathes and milling machine and micrometer dial gages.

Booth 660—Andrew C. Campbell, Inc., Bridgeport, Conn. Nibbling machines.

Booth 661—Ex-Cell-O Tool & Mfg. Co., Detroit, Mich. Bushings, grinding spindles and other products.

Booth 662—American Well Works, Inc., Aurora, Ill. Multiple-stage split casing centrifugal and deep-well cylinder pumps.

Booth 665 — American Air-Cooled Block Arch Combustion Co., New York City. Air-cooled furnace arches.

Booth 675-676 — The Tri-Lok Co., Pittsburgh, Pa.

Booth 678 — Leslie Co., Lyndhurst, N. J. Several classes and types of automatic pressure regulators and reducing valves.

Booth 679.— American Foundry & Equipment Co., New York City. Special castings for high pressures and temperatures.

Booth 680—Faatz Mfg. Co., Fredericksburg, Va.

Booth 681 — Combination Pump & Valve Co., Philadelphia, Pa.

Booth 682—Wheelock & Bogue, Inc., Boston, Mass.

Booth 693 — Ahlberg Bearing Co., Chicago, Ill. Single- and double-row radial thrust ball bearings.

Booths 694-695—Heine Boiler Co., St. Louis, Mo. Blueprints of typical Heine boiler installations and the design of a new high-pressure bent-tube type of boiler with enlarged photographs of installations. Also samples of boiler construction and special furnace apparatus. Representatives: C. R. D. Meier, E. R. Fish, W. Siegerist, C. L. Kline, R. L. Burke, John Daly, J. E. Strain and J. J. Brady.

Booth 696—The Meriam Co., Cleveland, Ohio. Engine indicators.

Booth 697—Palmer-Bee Co., Detroit, Mich. Mill-type speed reducers, I-beam trolleys, high-speed and mill-type flexible couplings.

Booth 698-699—Cooper-Hewitt Elec. Co., Hoboken, N. J. Cooper-Hewitt work light, quartz apparatus for ultra-violet radiations and konnectors which are glass-enclosed mercury contact devices for electrical circuits.

Booth 700—Skidmore Corp., Chicago, Ill. Vacuum pumps for condensing and heating system.

Booth 701—Industrial Power, Chicago.

Booth 712—Safety Engineering Magazine, New York City.

Booth 714 — Vulcan Radiator Co., Hartford, Conn. Extended surface tubing for radiators, heaters and condensers.

Booth 715—Justus Steam Trap Co., Napanock, N. Y. "Justus" Steam traps and thermostats.

Booth 716—Mixing Equipment Co., Inc., New York City. Various models of electric portable mixers for mixing practically all kinds of fluids.

Booth 718—Pulmosen Safety Equipment Corp., Brooklyn, N. Y.

Booth 719 — Engineering Products Corp., New York City. "Epco" masks in types A, B, C, D, and "Epco" ray screens.

Booth 719—Analox Paint & Color Corp., New York City. Paints and fillers.

Booth 731 — Naugatuck Mfg. Co., Naugatuck, Conn. Seamless copper floats for tanks, receivers, etc., and pump air chambers.

Booth 732-733—Oakite Products, Inc., New York City. Charts, blueprints and illustrations showing the applications of Oakite products in cleaning oil coolers, surface condensers and other similar equipment.

Booth 734—W. O. & M. Talcott, Inc., Providence, R. I.

Booth 735—E. G. Long Co., New York City. Products of the D. O. James Mfg. Co. and the American High-Speed Chain Co.

Booth 735—D. O. James Mfg. Co., Chicago, Ill. Worm, spur and herringbone speed reduction units, rawhide and bakelite pinions and flexible couplings.

Booth 735 — American High-Speed Chain Co., Indianapolis, Ind. Power transmission chains and sprockets.

Booth 735—Peoria Malleable Casting Co., Peoria, Ill. Samples of malleable castings.

Booth 735—Union Chain & Mfg. Co., Sandusky, Ohio. Conveyors, steel chains, sprockets and buckets for coal and ash handling.

Booth 737—Paul F. Hermann, Pittsburgh, Pa. Stationary and operating models of power equipment including model of a Koppers coke oven and an operating model of a dock pump.

Booth 738—B. Westermann Co., New York City. Technical books especially foreign publications.

Booth 738—Vastine Sales Corp., Chicago. Furnace fire observers.

Booth 739—S. F. Bowser Co., Inc., Fort Wayne, Ind. Bowser system for lubrication filtration and oil storage.

Booth 742—The New Jersey Asbestos Co., New York City. "V" Pilot semi-metallic packing.

Booth 743—The Jeffrey Mfg. Co., Columbus, Ohio. Jeffrey line of coal- and ash-handling equipment and motion picture of typical installations.

Booth 744—Nitrose Co., Peoria, Ill. Protective paint for metal surfaces.

Booth 745—Trill Indicator Co., Corry, Pa. Outside-spring and continuous-card indicators in operation, also check valves, planimetetrs and wire-centered cord for use on indicators, threeway and straight cocks. Representative, W. L. Trill.

Booth 749—Industrial Management & Industry, Illustrated, New York City.

Booth 750—Vastine Chemical Corp., Chicago, Ill.

Booth 752—L. C. Bigelow & Co., Inc., New York.

Booth 752—Wm. Ganschow & Co., Chicago. Several types of speed transformers and worm-gear speed reducers.

Booth 752—Hanson-Whitney Machine Co., Hartford, Conn. Tools and specialties.

Booth 752—Scully-Jones & Co., Chicago, Ill. Re-serviced machine tools and power-plant equipment.

Booth 753—Power House, Toronto, Canada.

Booth 754—The Rawlplug Co., Inc., New York City. Rawlplugs and a demonstration of their use, also, the Simbi hammer used for mounting various attachments and fixtures to masonry walls.

Booth 756 — Master Woodworker Mfg. Co., Detroit, Mich.

Booth 757—Biax Flexible Shaft Co., New York City. Rubbing down and polishing equipment for various materials and services, including stone, concrete, boiler cleaning, machine shops, etc.

Booths 758-759—The Texas Co., New York City. Samples of Texas products.

Booth 760—The Baldwin Chain & Mfg. Co., Worcester, Mass. Standard roller and precision silent chains operating over sprockets.

Booth 761—Cork Foundation Co., Inc., New York City. "Absorbo" cork foundation mats, used to absorb vibration and noise in turbines, engines, pumps, etc. Representatives: W. S. Tummis, J. W. Clissold, William Karl, Dore Sundland.

Booth 766-767 — Wisconsin Electric Co., Racine, Wis. Complete line of high-speed precision grinders and fractional horsepower motors.

Booth 766—Seneca Falls Mfg. Co., Bench lathes and tools.

Booth 767 — Swift Machinery Co., New York City. Tools and supplies.

Booth 768—Acorn Mfg. Co., Lynnbrook, L. I.

Booth 769—Sumet Corp., New York City. Sumet metal bearings. A bearing of this metal running dry at high speed will be demonstrated.

Booth 770—American Pipe Bending Machine Co., Boston, Mass. A type A standard 2-in. cold pipe bending machine and a type 02 1¼-in. cold pipe bender, also Type S Junior. Bends will be made on the machine during the show.

Booth 771—Imperial Coal Corp., New York City.

Booths 772-773 — Watson-Stillman Co., New York City. Steam specialties, including valves, fittings, accumulators and pumps.

Motion Picture Program at the Power Show

The Story of Brass and Copper
Mueller Brass Co.

The 20th Century Woodworker
20th Century Woodworker Co.

Oxygen: The Wonder Worker
Air-Reduction Sales Co.

Fighting Furnace Failures
Plibrico Jointless Firebrick Co.

The Manufacture of Genuine Wrought Iron Pipe
A. M. Byers Co.

The Fall of Man
National Safety Council and Tri-Lok Co.

The Electrical Giant
The Queen of the Waves
Anthracite Coal
Bituminous Coal
General Electric Co.

The Story of Asbestos
Johns-Manville, Inc., and U. S. Bureau of Mines

The Story of Abrasives
Carborundum Company and U. S. Bureau of Mines

Water Power
Transportation
Westinghouse Elec. & Mfg. Co. and U. S. Bureau of Mines

Saving Coal at Home
The Story of Steel
The Story of Alloy Steel
The Story of Power
U. S. Bureau of Mines

From Coal to Electricity
Stone & Webster, Inc.

The Future of Welding

WELDING is an infant industry. Its rapid expansion is due to the versatility of the process, supported by campaigns of research and education. With the makers progressive and the users open minded, welding will expand as fast as it can make good in new applications. Already the applications are distributed as broadly as is the use of metal in industry.

In the power field alone, welding is now well established for the fabrication of low-pressure steam and water lines, atmospheric-relief lines, breechings, bunkers, tanks, etc., and for repairs to engines, stokers, coal-and-ash-handling systems, and so on.

In the field of high-pressure piping welding may be said to have gained a good toe-hold. From a start where the weld was used merely as a seal, it is now frequently used to carry the actual load of high pressures.

Code restrictions and misgivings of engineers have retarded the application of welding to pressure vessels. It is to be hoped that tests to be made under the joint auspices of the American Welding Society and the Boiler Code Committee of the A.S.M.E. will make it possible for welding enthusiasts and conservative users to find some middle ground on which to compromise their present differences of opinion. Meanwhile, it is well to remember that pressure vessels are just one of many fields for welding.

Higher Turbine Speed

THE trend toward higher speeds for large steam turbines is exemplified by the Hudson Avenue machine described in this issue. It appears that turbine design is rapidly approaching the point where 1,800 revolutions per minute will be regarded as the usual speed for large turbines.

Higher speed leads to lower cost of the unit, since fewer turbine stages are needed for the same efficiency, and the generator is smaller. Limitations to speed lie in generator ventilation and the stresses in turbine rotors and buckets.

In this respect European practice has sometimes seemed to have an advantage in the use of fifty-cycle power. Their possible speeds are 750, 1,500 and 3,000 revolutions per minute. Our corresponding speeds, with sixty-cycle power, are 1,200, 1,800 and 3,600. Since the difficulties increase rapidly with speed, they often find it possible to use 3,000 or 1,500 turns where we must use 1,800 or 1,200. In consequence European machines are sometimes smaller than ours for the same economy. Their turbines have fewer stages.

Technical development by American manufacturers is fast making it possible for us to use the higher speeds, and for the same number of generator poles the sixty-cycle speed is higher than the fifty, so that as our difficulties are overcome more fully, we should ultimately be in a better position all along the line than our European brothers.

Every high-speed unit is a step in the right direction. The operating engineer, however, is naturally a conservative man and has a feeling, not without justification, that higher speed is to be avoided if possible. He must not let this tendency to play safe stand in the way of engineering progress. High speed is one of the prices we must pay for increased economy, smaller space, lighter machines, lower costs—all of them things that must inevitably become of increasing importance to the profession and to the nation.

The Romance of the Coal Conference

ONE frequently hears it said that meetings of engineers are intensely practical affairs that arouse little interest in the layman. This does not apply to the International Conference on Bituminous Coal recently held in Pittsburgh, and reported in last week's issue. No visitor left the Conference without a new vision of the future economic possibilities of that commonplace material, "soft coal." To the engineer many of the proceedings seemed like the happenings of a fairy tale, for the romantic and dramatic sides made a strong appeal. Every engineer must have received new ideas and new inspirations that will affect to a considerable degree his whole future professional life.

There was, for instance, the dramatic appeal of converting solid coal substance into liquid fuels by means of hydrogenation. There seemed to be an "Alladin Lamp" in the processes, described by speakers, in which water gas, so widely used and so familiar in every kitchen, could be converted into valuable alcohols and these in turn into still more valuable chemical products.

Catalyzers are surrounded with a mysterious romance of their own. Wherefrom do they derive this wonderful power of influencing and promoting the chemical reactions of other gases while they themselves remain unchanged? This power is quite uncanny to the layman. And then to think that such a maligned material as the ash of our coal may have powerful catalytic powers to influence, for better or for worse, the coking properties of bituminous coal and also its combustion characteristics in furnaces! Yet one of the British guests showed tests which indicated that such was the case.

One not only had the benefit of the ideas of fellow Americans, but scientists from France, England and Germany contributed valuable papers and discussions. The many informal gatherings and exchanges of experience and ideas between the formal sessions, were, without doubt, among the most profitable features of the gathering.

Truly, it was an eventful meeting in American Engineering life. The fact that fifteen hundred or more

engineers and business leaders would drop their daily work and come to Pittsburgh for four days to discuss new uses for bituminous coal is in itself a new and unusual occurrence and one that savors well of intelligent future progress. Great credit is due to those of the Carnegie Institute of Technology who conceived the idea of such a conference and who made it effective.

Keep the Windings Clean

CLEANLINESS and the prevention of fires in electric generators are closely associated. If the windings are allowed to accumulate dust and oil, and then if conditions favorable for starting a fire develop, the results are generally disastrous for the windings. Where the windings are clear, the possibilities of damage to the windings are greatly minimized.

According to the report of the Power Generation Committee of the American Institute of Electrical Engineers, the outage time of steam turbo-alternators was reduced thirty-six per cent in the periods for 1923 and 1925. There are probably other factors that contributed to this decrease, but it was in this period that the closed system of ventilation was generally adopted, and this no doubt accounts for a large portion of this decrease in outage time.

Where air is continuously taken from outside the machine and passed through its winding and ventilating ducts, it is practically impossible to keep large quantities of dirt from getting into the generator. Assuming that the air is cleaned so that it contains only one part of dirt in one hundred million, a machine requiring sixty thousand cubic feet of air per minute, in five thousand hours' operation will carry into its windings and ventilating ducts nearly two hundred cubic feet of dirt. Only a small part of this need remain in the machine to create a serious fire hazard. This also shows the hopelessness of attempting to keep dirt out of the machine if air from the outside is to pass through it continuously.

Why Be Satisfied with Existing Efficiencies?

TEXTBOOKS have reiterated so frequently that the Diesel engine works upon the most efficient available cycle that its closest friends have accepted it as a literal truth, and so rest content. While the steam-plant cycle has been altered, improved and even completely changed, with an improvement in efficiency following each step, the Diesel engine of today shows little if any improvement in fuel consumption over the earliest unit. The result has been that while the Diesel has remained stationary, the steam plant has now arrived at a point where it is almost, if not quite, as efficient.

In view of the recoverable losses it is somewhat to the discredit of the designers and builders of oil engines that more of them have not assayed to reduce the sum total of these losses. The Still engine is one effort in this direction that does recover the jacket-water heat and part of the heat contained in the exhaust. The design of the engine cylinder, however, is so unconventional and expensive that it is questionable if any great number of builders will ever feel justified in adhering very closely to the design. Manufacturing costs, after all, largely determine the success of any apparatus.

The exhaust gases do carry away a large amount of energy, much of which can be recovered. Usually, this is considered in terms of hot water or steam for process work. In all instances such services are not needed, at least not continuously, and the standardized engine cannot economically be designed to include the equipment.

On the surface at least, the obvious utilization of the exhaust energy is through some apparatus that can be used in all situations. In two-stroke-cycle engines the scavenging pump is a necessary adjunct and consumes a considerable percentage of the developed power. Through the application of an exhaust gas turbine driving a blower, the pump can be replaced, at a marked saving in operating costs. Still another method tried out experimentally is the use of an exhaust-gas boiler which supplies steam to an eductor nozzle of the Köerting type. The steam jets draw in and pass to the scavenging manifold the air needed by the engine cylinders.

The capacity of the oil engine is, after all, a question of air charge. Even in four-stroke-cycle units supercharging would be economical if the extra energy in the exhaust by reason of the higher terminal pressure, was recovered.

Net efficiency in both cycles would be improved and of equal importance. The first cost would probably be less than at present.

Utilizing Waste Heat and Fuel

ELIMINATION of waste in industry is one of our great national problems, and its ramifications are almost limitless. The iron and steel industry offers tremendous opportunities for the utilization of waste heat and fuel. Just what these possibilities are is indicated in the leading article in this issue, which tells of some of the accomplishments at the Cambria Works of the Bethlehem Steel Corporation. In this works eighty per cent of the steam produced by 186 boilers is obtained by using waste fuel and heat, and when this company has completed its efforts along these lines, there are possibilities that practically no raw coal will be burned under its boilers.

The utilization of these waste products of the processes offers many difficult engineering problems. The method developed at the plant in question, for burning coke screenings with bituminous coal, is illustrative of such problems. One of the first thoughts would be to mix the two fuels intimately together, which was first tried, but proved unsuccessful because the two would not stay mixed. The solution to the problem was found in keeping the two separate until they reached the underfeed stoker ram boxes. Coke, which is unlike bituminous coal in many of its qualities, has naturally increased the operating difficulties, but these are being solved.

These products provide a means for producing power at a very low cost, as the chief items of cost are those for operation, maintenance and capital. The fuel cost should be chiefly handling charges, and in some cases this could hardly be considered a legitimate charge, since the material must be handled whether it is utilized or not.

Everything considered, the operation of the installation in question has proved satisfactory and means have been provided for utilizing a byproduct material for which there is no market. It has also made a substantial contribution toward the conservation of fuel resources.

Practical Ideas From Practical Men

Oiling Device for Silent Chain Prevents Excessive Wear

The wide adoption of silent chains on power-house and industrial drives has not been accompanied by very much literature on their operation. Yet the life of a silent chain depends primarily on the care given it after it has been properly installed. One typical installation will be described, with the method of overcoming certain difficulties.

In a large power house the generators are ventilated by means of a multi-blade fan having a rated capacity of 50,000 cu.ft. of air per minute and driven by a 15-hp. squirrel cage motor operating at 865 r.p.m. with a fan speed of 230 r.p.m. The fan and motor were connected by a silent chain with a 0.9-in. pitch, 3½ in. wide and a total length of 10.2 ft. The pinion was 5.44 in. and the sprocket 19.37 in. in diameter. The chain was slightly wider than that recommended by the maker. The difference in elevation of the respective shaft centers was about three feet. A riveted case covered the chain as a splash and safety guard and was split in halves through the shaft center lines, as shown in Fig. 1.

It was not possible to run the chain in an oil bath, so for the first year intermittent hand oiling was em-

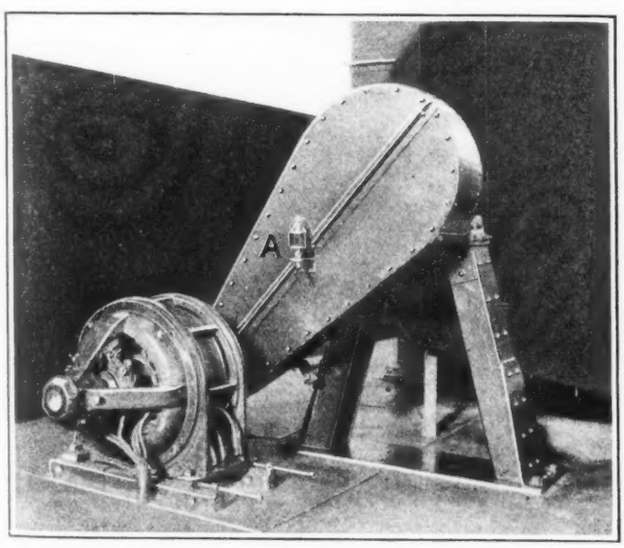


Fig. 1—Silent chain oiled from lubricator located at A

ployed, using both light cup grease and oil. The chains did not last over one year and the sprockets and chains were renewed. The lubrication method was changed to a continuous feed system using an engine oil by means of a sight drop lubricator. The feed was adjusted to about one-half pint of oil per day, and it was applied to the inside surface of the chain by attaching a 45-deg. ell and a short section of pipe which extended through the side of the case and terminated close to the center of the chain.

The chain has operated over a year now without even requiring the taking up of slack by means of the adjustable motor base. It runs without the noise or squeaks that were present under the old system of lubrication. It is rather early to predict the increase of life given the chain, but as it has exceeded the old life without evidence of wear, a quadrupling of the length of service may be expected. The amount of lubricant used is not

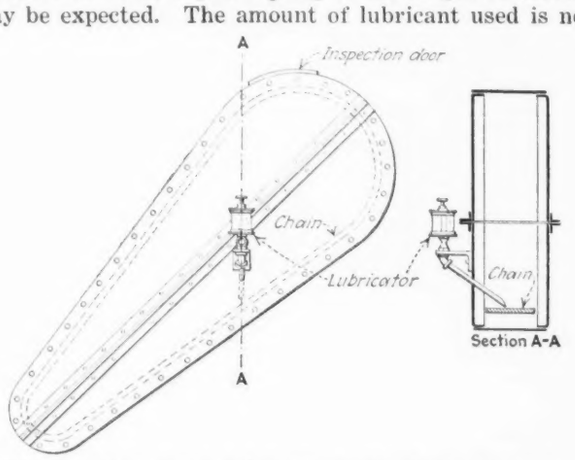


Fig. 2—Pipe from lubricator extends in to center of chain

greater than that formerly required, but the chain is kept saturated and it is not thrown off by centrifugal action as would be the case where the oil was applied to the outside of the chain. A small quantity of the oil is reclaimed from the chain case and filtered for lubricating rough machinery.

The main points to consider in operating any silent chain would appear to be, securing and holding accurate alignment, protection against dusty conditions, avoidance of excessive tension in the chain and the attainment of a condition of continuous saturation of the chain with oil.

J. ELMER HOUSLEY.

Alcoa, Tenn.

Found Uneven Cutoffs

Some time ago, upon taking charge of a plant one unit of which was a 150-hp. Corliss, I observed that this engine was acting logy. It was driving a belted 110-kw. alternator, and with about half the load there would be a wave in the slack side of the belt, causing a constant slipping, to correct which an excessive amount of belt dressing was used.

There being no indicator at hand, I decided to give the valves an inspection. Upon removing the bonnets, I found the valves out of adjustment a small amount, but not enough to cause the engine to behave as indicated.

I adjusted the valves until they were right, then removed the cylinder head. There I found the piston rod running a very small amount out of center and the cylinder walls slightly scored, but neither of these discrepancies was enough to cause the unsatisfactory

operation of the engine. I centered the rod in the cylinder and treated the cylinder walls to a generous application of cylinder oil and graphite, put in the head, and resolved to inspect the governor setting at the first opportunity.

I blocked the governor in mid-position and found that in this position it was tripping the valve at one-third stroke at the crank end of the cylinder and at about one-tenth stroke at the head end. With the governor still in mid-position I adjusted the reach rods until the valves tripped at 20 per cent of the stroke at each end.

When the engine was put back in service, the wave in the belt disappeared, the annoying squeaking ceased, the engine would take up its load without signs of distress, and the consumption of coal when this unit was in service was reduced 25 per cent from what it was before.

Dayton, Tenn. J. R. WILSON.

Changing a 120-Volt Motor for Operation on 240-Volts

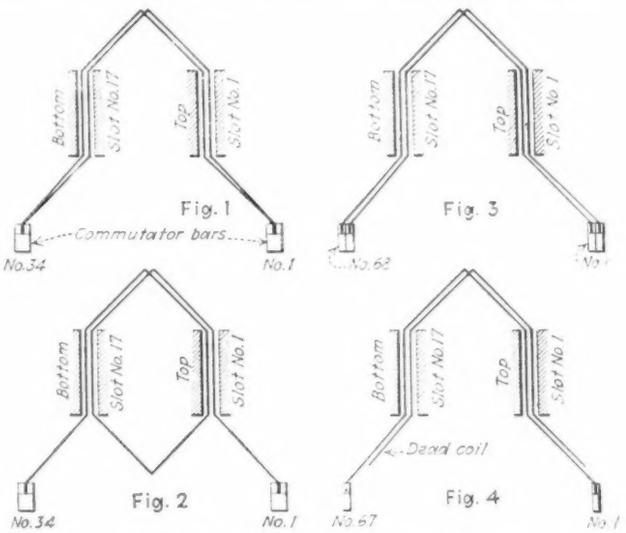
Rewinding a direct-current machine for a lower voltage generally affords more flexibility in doing the job than when going from a lower to a higher voltage. For example, when changing from 240 to 120 volts, the field coils can be divided into two groups and those connected in parallel for 120-volt operation. If the change is made from 120 to 240 volts, then the field coils must be rewound with double the number of turns in the original coils, with wire one-half the cross-section of that used for 120 volts.

Some time ago I had the problem of changing the winding in a 120-volt 25-hp. 6-pole direct-current motor for operation on 240 volts. Under the average conditions it will be necessary to rewind both the armature and the field coils. The problem of the field coils was easily settled, as there was only one solution, as previously pointed out—to rewind the coils with double the number of turns and halving the cross-sectional area of the wire. This meant using a wire three sizes smaller than the original. For example, in this case No. 12 double-cotton-covered wire was used on the 120-volt field coils. The 240-volt field coils were wound with No. 15 double-cotton-covered.

In the armature there were 100 coils connected in a single-series winding. The coils were made of two $\frac{3}{16}$x$\frac{3}{8}$-in. copper bars in parallel, insulated from each other. The coils had a throw of slots 1 and 17, and the lead pitch was commutator bars 1 and 34, as shown in Fig. 1. This connection gave the maximum voltage that could be obtained for any grouping of this winding, therefore some other method had to be tried to obtain double voltage. The first thought was to connect the two turns in each coil in series, as indicated in Fig. 2. As the coils were made with one turn of a flat bar, closing the commutator ends of the coils would make it practically impossible to get them in the slots and the leads to the commutator. Therefore this arrangement was abandoned.

The other solution was to use a new commutator having double the number of bars of the one used for the 120-volt winding, or one with 200 segments. This would allow using each coil in the winding separately. The insulation between the two coils in each group was tested and found to be in good condition, therefore the coils did not have to be removed for insulating.

Could the 200 coils and 200-bar commutator be connected into a single-circuit series winding? This had to be determined. The coil-lead pitch for a single-series winding is obtained by the formula $Y = \frac{B+1}{S}$, where Y equals the coil-lead pitch, the number of bars included between the leads of a coil and must be a whole number; B equals the number of bars in the commutator, and S equals the pairs of poles. Then in this problem, the coil-lead pitch $Y = \frac{200-1}{3} = 66\frac{1}{3}$, or $\frac{200+1}{3} = 67$; that is, the coil leads span 67 segments on the commutator. If No. 1 lead connects to segment No. 1, the other lead of the coil will connect to segment No. 68, as shown in Fig. 3. A commutator having 200 segments was obtained and the winding connected as indicated.



Figs. 1 to 4—Show coil-lead pitch on the commutator

On the 120-volt machine the commutator operated with flush mica. As there was considerably more insulation in the 240-volt commutator, it was decided to undercut the mica and obviate any chance of trouble from high mica. As the winding was a series grouping in either case, the arrangement of the brushes on the commutator did not have to be considered. When changing the winding for a higher voltage, the current-carrying capacity of the brushes does not have to be considered, as the higher voltage will require a smaller full-load current than the low-voltage winding.

The type of winding chosen is what is known as a progressive, or long-pitch winding. This means that in passing through a series of coils it will end one bar ahead of the one it started at. A retrogressive, or short-pitch, connection could have been obtained by leaving one coil dead in the winding, thus using 199 coils and a 199-bar commutator. The dead coil is left in the winding, as indicated in Fig. 4. The leads of one coil are cut back to clear the commutator and are insulated. With 199 active coils and bars the coil-lead pitch $Y = \frac{199-1}{3} = 66$; that is, the coil-lead pitch is commutator segments 1 and 67. In this winding a series of coils end on the segment back of the one started at. There is little choice between the two connections, except in this case the progressive connection utilizes all the coils.

P. W. SAWYER.

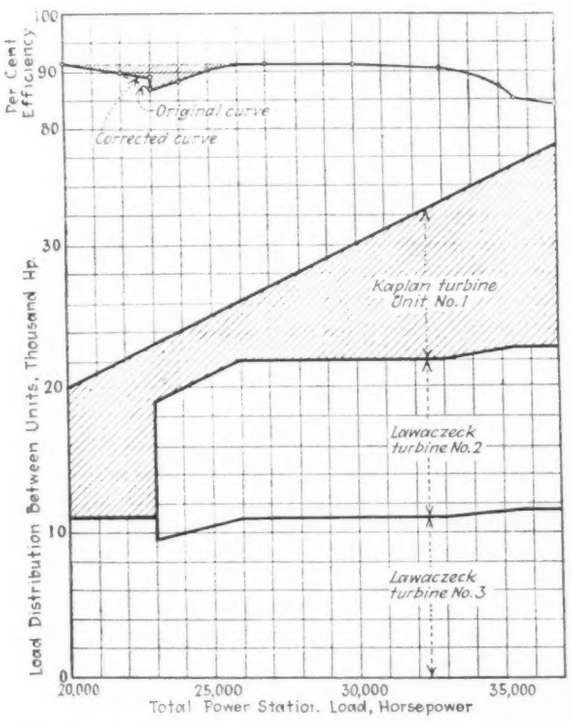
Cleveland, Ohio.

Comments from Readers

Turbine and Plant Efficiencies at Lilla Edet Station

In the Oct. 12 issue of *Power*, page 560, characteristic curves were published relative to the Kaplan and propeller-type turbines installed in Lilla Edet water-power station, in Sweden. Fig. 2 of this article illustrated the method followed in this station, in distributing a variable station load between the two Lawaczeck propeller-type turbines and the Kaplan, so as to maintain the highest possible combined efficiency for the three units.

There is a slight inaccuracy in the combined efficiency curve, as published by the writer in Fig. 2 of this



Curves of efficiency and of load distribution

article. When unit No. 2 is put in service, the station load, previously borne by two machines, must be redistributed among three. The three units are then underloaded, and their individual efficiencies are reduced, consequently, there results a break in the continuity of the combined efficiency curve, as shown in the accompanying figure.

In itself this error is small and almost negligible, yet it ceases to be so in the computation of the energy loss due to the "valleys" in the efficiency curve. Assuming the station load to be a straight-line function of time and the maximum combined efficiency of the three units to be about 91.5 per cent, then the area cross-hatched in the figure would be closely proportional to the energy loss due to the falling off of the efficiency from the maximum value, in the neighborhood of the transition point between two- and three-unit service. The area inclosed above the curve as first published, and reproduced in dotted line, is approximately 15 per cent greater than the correct area, and therefore materially exaggerates the power loss due to the drop in combined efficiency.

R. H. ANDREWS.

Paris, France.

Causes of Turbine Vibration

In the last twenty-five years designers, engineers and operators have been announcing new cures for turbine vibration, and doubtless many thousands of dollars have been spent in research and experimental work to eliminate this evil. Still today, for unknown reasons, an old turbine that has been in service for many years will have a spell of vibration and, when stopped and started again, may run for months without a recurrence of the trouble.

Some fifteen years ago, in a Southern city, a new plant was built to have three 5,000-kw. turbines. During the roof construction a scaffold was hung under the trusses to take down the form lumber used in building the concrete roof. Directly over No. 1 turbine foundation the roof concrete was "green," and when the forms were removed, the concrete came down, broke the ropes that held the scaffold, and sixteen men were dropped about 45 ft. Four colored men and two white men were killed on the foundation, and one man was killed in the atmospheric exhaust pipe.

During transit, on the day of the accident, one car of turbine parts ran off a derail switch and into a mud hole, causing considerable delay.

Finally, the turbine arrived, and every man employed by the company said "She's a hoodoo," "She'll never run," and many other remarks, discouraging to an erecting engineer, were made. True to suspicion, the machine vibrated badly, and every cure then known was of no avail for a long time. Finally, it was decided that the base was not properly leveled and should be releveled and regrouted. Wedges were made, and it so happened that I placed the first wedge exactly at the center of the base lengthwise. Imagine my surprise when the first stroke of the hammer drove the wedge under the machine over an inch, and a few strokes drove it to its full 1 in. thickness. My first thought was "frozen grouting," but it doesn't freeze in that part of the country. Then inquiry was made as to where the cement came from which was used to grout the machine. Then the truth came out. The cement was kept in the basement, and the fireclay in the boiler room. It was a shorter distance to the fireclay than to the cement, so the men had mixed half-and-half in order to finish more quickly, and as they explained later, they used fireclay in boiler work, why not in concrete also? After regrouting, the turbine ran all right, but to this day I do not think you could get a colored employee to pass directly by that machine when it is running.

I trust the foregoing will convey to the readers of this article the thought that is intended. Turbine vibration can be caused by so many different things that a preventive or cure-all is not easy to prescribe. Many cases are on record of machines that vibrate on holidays or Christmas eve on heavy loads, and many more run well with heavy load and rough on light loads.

In one station carrying a railroad load was an old-type 1,500-kw. machine that would run rough when No. 7 boiler was on the line, and months of tireless effort were required to find that No. 7 boiler primed on light load, which caused the turbine to vibrate. There are a few more interesting cases of vibration that can be found today caused by certain operating conditions, some of which the manufacturer has failed to overcome either in the shop or in the field.

It would be interesting to many readers of *Power* to have some engineer relate his experiences with a turbine vibrating on the load when no other machine was available, and how he was able to keep on the line.

Chicago, Ill. CARL WILDEY.

The Engineering Graduate

There has been considerable discussion in *Power* on the subject of engineering graduates failing to make good, and I believe the attached clipping from the *Literary Digest*, entitled "Mr. Wells Attacks Colleges," will prove of interest:

H. G. Wells looks forward to a time "when Oxford and Cambridge, Yale and Harvard, will signify no more in the current intellectual life of the world than the Monastery of Mount Athos or the lamaseries of Tibet do now." In fact, intimates Mr. Wells, the chief present use of our large colleges is to give the modern youth a chance to waste his time. People "send their boys trustfully and hopefully to these overrated centers," where the young men "find themselves confronted with pleasant, easy-going, evasive young men up to nothing in particular, and schooled out of faith, passion or ambition." He comments:

"I think we must be prepared to cut out this three- or four-year holiday at Oxford or Cambridge, and their American compeers, from the lives of the young men we hope to see playing leading parts in the affairs of the world. It is too grave a loss of time at a crucial period; it establishes the defensive attitude too firmly in the face of the forcible needs of life.

"We are parting from the old delusions that learning is a mere phase in life. And all the antiquated nonsense of calling people bachelors and masters and doctors of arts and science might very well go, with the gowns and hoods that recall some medieval alchemist or inquisitor, to limbo. They mean nothing. There is no presumption that a man who has the diploma, or whatever they call it, of M. A., is even a moderately educated man.

"One may argue that to clear out the colleges and disperse the crowds of spoiled and motiveless youth that now, under a pretense of some high and conclusive educational benefit, constitute the physical bulk of Oxford, Cambridge, Yale and Harvard, is not to put an end to universities; but the value of that argument depends upon the meaning we assign to the word university."

During the past years of my work in the power-plant field I have from time to time had graduates in mechanical engineering assigned to me for a sort of post-graduate course, and I can recall only one that was willing to mix his technical knowledge with the dirt and grime of the engine room; all the others were averse to crawling into a boiler, getting down into a pump pit or doing any work that might soil their hands. It might have been that they thought it would lower their dignity a bit, and the one that did get dirty, I am glad to say, is making good, while the others have fallen by the wayside. Not long ago I was discussing this subject with a young man just out of college, and I asked him why he selected the college that he did, and he replied: "Well, I asked quite a number of fellows that were in several of our colleges, and they all agreed that this one led all the others in sports." There you are, and this young man could tell the names of all the coaches, football moguls, etc., but he could not explain the action of the Corliss valve, and the difference between a four-valve engine and the uniflow was beyond his "ken."

I know that technical knowledge is valuable, but I maintain that it has to be thoroughly mixed with practical experience, and pretty well mixed, too. In my opinion the young man that wants to make good in engineering should get a job in some large power plant and work through it from A to Z, and at the same time study during his spare hours and keep his mouth shut, and eyes and ears open. If he will do this, any "old timer" will be glad to show him and give him points on just what books and technical papers to get. If he does this, he will, in my opinion, be better equipped in three years than the college man is in four, or even eight.

After all, when the power fails and the works are tied up, we find that "Bill" the "old timer" is often the man that puts the wheels moving and does it while the college fellow is trying to figure out the cause of the trouble by his slide rule and calculus. I take my hat off to the man who has sweated and toiled with the machinery in the day and put in hours at night studying the why and wherefore of it. He is the one that "has it" and it never gets away from him. THOMAS M. STREET.

Wilkes-Barre, Pa.

Why is the Vacuum Low?

The data submitted by A. W. Napier on the 4,000-sq.ft. surface condenser serving a 2,000-kw. turbine show a 16-in. vacuum, 100 deg. F. intake, 121 deg. F. discharge and 170 deg. condensate. He gave a very complete description of the circulating water, spray pond, etc., but did not state the type of air removal pump, if any.

By referring to a steam table, he will find that with a 121-deg. discharge he should have at least a 27-in. vacuum, with the usual temperature difference between the cooling water and the condensate. In other words, since the condensate temperature 170 deg. corresponds to the actual vacuum readings, there is failure somewhere in the air removal. Either the air pump needs attention and is not handling its rated volume, or else there are entirely too many air leaks.

If there is a means for blanking off and testing the vacuum-pump dead end, that should be done first. If the pump tests satisfactorily, the next move should be to fill the condenser with water and find the leaks. It may be at the expansion joint between the condenser and the turbine, or the cause of the trouble may be in the turbine itself.

In case no leak shows up before the water reaches the turbine, it might pay to have a competent condenser man look it over. It scarcely pays to waste time hunting for a bad leak when the loss of steam in a day's run would pay the expense of an expert engineer.

Nanticoke, Pa. J. KUNSON.

Middle Age and Opportunity

The editorial, "Middle Age and Opportunity," in *Power* Nov. 2, is fertile of thought and well worth pondering over for the engineer who has not reached the age of 45.

The engineer of middle age who has a permanent position, even though it is not entirely satisfactory, should think twice before making a change, for making a change always involves a risk. The new position may not prove to be any more satisfactory than the former, or it may not even be permanent.

What are the reasons that capable engineers past these years have difficulty in securing desirable positions? For one thing it is to be remembered that it is usually difficult for a man of any age to make a desirable connection as an operating engineer in charge of a plant. One reason for this is that these are desirable positions to which the incumbent frequently sticks all of his active life, and when he resigns to assume a better job or when he retires, such positions are frequently filled by an understudy, which is the way it should be.

A good deal is being written in the columns of *Power* about the hard lot of the operating engineer on account of the social deprivations due to long hours and poor remuneration, etc. And while there are many such cases, which with going concerns are unnecessary and inexcusable, this is not universally true. The trend is toward better conditions, and I believe that the plants where the engineer can enjoy the advantages that men in other walks of life can enjoy are on the increase.

In the last analysis it is up to the engineers to better these conditions. It is up to the engineers to demonstrate to their superiors that it is more profitable to operate their power plants under agreeable than under disagreeable conditions.

The means by which this is to be brought about is by bettering the education of the engineers. I think it is an incontrovertible fact that only until recent years the operating engineers have paid little attention to education and that likewise the efforts toward education in recent years are bearing fruit. In the future the operating engineer must not confine his education to the technique of his profession, but he must also learn to understand business and learn to speak the business language.

Many engineers who have a good technical background fail to get recognition because they are not able to make suggestions and recommendations in the business language. In other words, they are not able to show the advantage in dollars and cents and in improved service in black and white.

Then, too, it is to be regretted that many executives are being disappointed in carrying out the recommendations of their engineers who have based their recommendations on the unconditional guarantees and talking points of salesmen who were not engineers. Cases of that kind are chargeable to nothing else than the lack of education or incompetence of the engineers. Is it any wonder, then, that some executives will only consider men who are young and plastic-minded and educated up to the minute?

The fact that an engineer past 45 finds it necessary to look for another job should not necessarily reflect upon his ability as an engineer. There are cases, however, where suspicion would be justified. There are many men who, having no vocational ambition or pride, will not venture for the sake of broadening their experience. They are contented with having merely a "good job." If such find it necessary to look for new connections after having been stationary for twenty or more years, they will very likely find it difficult to obtain consideration for a position as good or better than the one vacated. On the other hand, if an engineer who persistently strives to train himself better and does not shirk assuming greater responsibilities in order to broaden his experience in anticipation of probable greater opportunities in the future, he will be a more valuable man at 50 than he was at 40 or 45. The writer, being a middle-aged man, would resent the intimation that he was a more valuable man ten years ago or that with abiding health he would be less valuable 10 years hence. Where are the executives or owners of industries of 55 or 60 who are willing to concede that they are less capable than they were at 35 or 45?

The possibility of a longer period of service from a younger man is not a sound argument in his favor. If he possesses the ambitions of the progressive business man, and is capable, he will be open for a better position with some other firm, while the elder will be more cautious on account of the prejudice against his age.

Will a younger man start for less remuneration? If opinion is in favor of the younger man, is he not worth more? With a going concern, where competence is always an important factor, does a difference in salary deserve any consideration? The cost of operating the industrial power plants with fixed charges and overhead included, though operating inefficiently, seldom exceeds 3 per cent of the gross business. If the plants operate without any unnecessary interruption and if by paying the proper attention to the economical operation, anywhere from 5 to 10 per cent can be saved on the fuel consumption, why does a difference in the engineer's salary deserve any consideration?

There is now a large variety of equipment, making plants differ much one from the other. Consequently, the young engineer of 25 years ago, who is the older engineer of today, was not subject to the urge of necessity to acquire the technical and business knowledge and of adapting himself to the changing conditions that prevail today. While it is not always true, it is nevertheless frequently the case, that with advancing years the odds are against a man on account of his inability to adjust himself to a new environment.

The chief qualifications that the modern plants call for are a specialized knowledge, experience and sound judgment, and middle age should be an aid rather than a hindrance.

WILLIAM TIETZE.

West Allis, Wis.

[Mr. Tietze confines his observations largely to the operating engineer. However, the editorial was prompted not by the number of operating engineers over 45 who are unemployed, but by a noticeable condition among professional engineers.—Editor.]

"In less than a generation the present methods of shipping coal to be burned in its raw state under boilers hundreds of miles from the mines will appear to have been primitive and rudely unscientific," said Thomas S. Baker, president of Carnegie Institute, in his remarks opening the Conference on Bituminous Coal, Pittsburgh, Nov. 16-19, 1926.

News in the Field of Power

Cites St. Lawrence Power Potentiality—Engineers Favor River as Waterway

Canadian-American Board Holds Rival Plans To Be Adjusted—Project Promises 5,000,000 Hp. Eventually—Cost Fifth of All-American Canal

DEEPENING the St. Lawrence waterway route from Montreal west so as to provide access from the Great Lakes to the Atlantic by a 25-ft. channel is feasible, and the route could be canalized for both navigation and power development, according to the form of the improvement, at costs varying from $350,000,000 to $650,000,000, the joint Board of Engineers of the United States and Canada appointed to examine the project decided in its report, made public at the War Department Nov. 24.

The report, a brief abstract of which had been sent out from Ottawa, shows that the St. Lawrence route to the sea can be opened for about one-fifth the cost of the proposed all-American canal through the State of New York.

When Congress meets, the report will be forwarded to that body, and at the same time the Army engineers will submit their separate report disapproving the all-American route across New York State to connect with the Hudson and carry Great Lakes traffic through the Port of New York. There would be nine locks and eight bridges along the St. Lawrence route, as against twenty-five locks and fifty bridges along the all-American canal.

Power Potentialities

The Canadian-American Board of Engineers suggests that power be developed along the St. Lawrence River to the extent of 1,365,000 hp. immediately. It visualizes ultimately an output of 5,000,000 hp., and the value of this is figured commercially at from $100 to $150 per horsepower.

The plans recommended by the joint board provide for a navigation route through the 183 miles of river and lake from Lake Ontario to Montreal Harbor, with a total not exceeding twenty-five miles of restricted canal navigation.

The estimated expenditure required to open navigation with channels 25 ft. deep, with an initial power development having one-half the ultimate installed capacity of the power house first constructed (the installation of the remainder being deferred to await the growth of the market) is as follows:

1a. Total cost of improvement if with a single-stage development in the international rapids section (1,365,000 hp. initially installed), $350,100,000; or

1b. Above improvement before channels are enlarged to insure winter operation, $337,100,000; or

2a. Total cost of improvement if with a two-stage development in the international rapids section (1,365,000 hp. initially installed), $385,500,000; or

2b. Above improvement if the initial power installation in the international rapids section is all made at the lower (Barnhart Island) plants, $361,600,000.

After all the machinery in plants recommended by the board has been installed, those costs will become respectively:

1. If with a single-stage development of the international rapids section (2,730,000 installed horsepower), $394,000,000.

2. If with a two-stage development of the international rapids section (2,619,000 installed horsepower), $423,600,000.

Estimates Allow Latitude

"The estimated cost of additional works required to complete the full practicable development of power in the river, with works having an installed capacity of 2,500,000 hp," the report declares, "is approximately $225,000,000. The total eventual power installation visualized is therefore 5,000,000 hp. And the total eventual cost of developing this power, and of providing navigation with channels 25 ft. in depth, is in round numbers from $620,000,000 to $650,000,000, depending upon the form of improvement adopted in the international rapids section.

"In such an extensive project as that for the improvement of the St. Lawrence it is not possible, even in the time consumed by the board in its investigation, to arrive at the best possible design of all features of the project, both for navigation and for power," says the report. "The estimates are based on safe and adequate structures and channels, but it is expected that the responsible authorities in charge of the construction will exercise the usual latitude in making such alterations as are found to be desirable in consequence of more detailed studies, and the development of the art."

Rival Plans Discussed

"The United States section of the board," the joint report explained, "recommends the single-stage development as affording better navigation, by eliminating one lock and slightly more power at a cost of $29,600,000 less than the cost of a two-stage development.

"The Canadian section of the board recommends the two-stage development on the ground that it can be carried out in two parts, so that the power from the upper development can be developed and marketed before the whole of the improvement is completed. It believes that for this reason its over-all cost, including interest charges, will not be as greatly in excess of the single-stage development as appears from the comparative costs without interest charges. It believes that the control over the flow of the river will be better assured. The flowage of land will be reduced from about 28,000 acres to about 18,000 acres.

"Whatever plan be adopted, there is a choice of sites for the dam and power houses in the vicinity of Barnhart Island that creates the pool of the single-stage development, or the lower pool of the two-stage development.

Power Transmission Body Elects Officers

The second general meeting of the organization committee of the Power Transmission Association was held Wednesday, Nov. 17, at the Pennsylvania Hotel, New York City, with representatives present from a large number of leading manufacturers of mechanical power transmission and allied equipment.

W. H. Fisher, chairman of the Organization Committee, presiding, introduced Frazer M. Moffat, president of the Tanners Council of America and E. J. Mehren, vice-president of the McGraw-Hill Publishing Co., who spoke briefly on the ideals and purposes of trade associations and their value in promoting closer co-operation in the solution of problems that are of mutual interest.

Mr. Fisher then presented the report of the Organization Committee, in which it was shown that a great deal of interest had been shown in the purposes of the association by manufacturers in this industry, and that to date 104 companies had signified their intention of joining.

Upon receipt of the report of the Nominating Committee appointed by the chairman, the following officers were unanimously elected: President, W. H. Fisher, sec. and sales manager, T. B. Wood's Sons Co.; vice-presidents representing leather belting manufacturers, F. H. Willard, president Graton & Knight Mfg. Co.; tanners and curriers, Edward D. McKown, vice-president, Hans Rees' Sons Co.; power transmission equipment manufacturers, George H. Miller, president, Dodge Mfg. Corp.; pulley manufacturers, William R. Simpson, vice-president, the American Pulley Co.; hanger manufacturers, S. A. Ellicson, president, Chicago Pulley & Shafting Co.; accessory manufac-

turers, Wylie K. Lee, president, Clipper Belt Lacer Co.; fabric-base belt manufacturers, B. J. Kielly, president and general manager, R. & J. Dick Co., and treasurer, L. H. Shingle, president Shingle-Gibb Leather Co.

Hoover Outlines Opinion on Hydro-Development Control

In defending his St. Lawrence policy by quoting utterances of Secretary Hoover as to the Colorado project, the action of Governor Smith, of New York, has given rise to a demand to know just what limits Mr. Hoover would prescribe for public and private development on rivers. He answered the question in his Seattle speech when he said:

"It appears to me obvious that where the major purpose of a given development is navigation or irrigation, reclamation or flood control, then either the federal government or the states or some particular local district must assume the burden and ownership of the permanent works.

Against Federal Operation

"Our problems become more complex when electrical power is involved. It is my own view that the federal government should not go into the business of either generating or distributing electrical power. There may be some special cases, but our general policy should be against it. Where power is a byproduct of dams for other major public purposes such as navigation, etc., then the federal government should lease the power rights so as to recover as much or the whole of its total investment as can be. Where the development is for power only, then it should be leased under provisions of the Federal Water Power Acts which amply provide for control by the government. Where such major electrical development may in minor part affect the other purposes of irrigation or domestic water storage, etc., then the rights of these users can be protected by conditions in the leases and those acts.

Rates States' Responsibility

"The federal government cannot completely enter into the business of generating and distributing power for many reasons, one of the least of which is that it cannot secure for isolated blocks of power such a diversity of load that it will yield a high daily load factor and consequent maximum use. That can be obtained only through our large inter-connected power systems.

"The regulation of our utility rates to protect the public is the responsibility of our state government."

International Combustion To Build English Plants

Arrangements have been completed by the International Combustion Engineering Corp. for the erection in England immediately of two low distillation plants, one under the Essen (K-S-G) process, with a capacity of 500 tons of coal a day, and one under the McEwen-Runge process, with a capacity of 200 tons of coal a day, it has been stated by George H. Hansel, treasurer, in a letter to stockholders explaining the purpose of the new stock issue of 32,307 shares which has been underwritten in England.

It is contemplated that additional plants for the low distillation of coal under these processes of the corporation will be erected in France in the near future.

"As the corporation requires all of its present working capital to provide for its rapidly increasing business, it has been voted to issue 32,307 shares of new stock of the corporation to be offered for subscription to the stockholders at $47 a share to finance this development of the corporation's business abroad," further explained Mr. Hansel's letter.

A.S.M.E. Novel Excursions for Annual Meeting

Excursions during the 1926 American Society of Mechanical Engineers annual meeting, Dec. 6-9, will, as usual, be intimately related to some of the subjects under consideration at the technical sessions, and so will serve to illustrate clearly and to bring out forcibly some of the statements which will be made. A point worthy of notice is that several of the places to be inspected are not generally open to visitation.

All the trips will start from the Engineering Societies Building, 25 West 39th St. On Tuesday, Dec. 7 at 2:00 p.m. the first inspection trip will cover the Kips Bay station of the New York Steam Co., located at 35th Street and East River. When completed this will be the largest plant in the world devoted to the generation and general distribution of steam for heating and industrial power. The first unit of this plant is just now going into operation.

After covering this plant the party will proceed to the new East River station of the New York Edison Co., 14th Street and East River. This station is also in the process of erection, and one unit has just been started. It will be the largest power plant in the world, with an ultimate capacity of about 1,000,000 kw. Pulverized-fuel equipment with full automatic control is being installed.

Through the cordial invitation of M. S. Sloan, president of the Brooklyn Edison Co., an inspection of the Hudson Avenue Generating station, located at the foot of Hudson Avenue, Brooklyn, will be made the afternoon of Dec. 8.

A visit has also been arranged for this afternoon to the American Machine & Foundry Co. This concern has a very large plant in South Brooklyn devoted to the manufacture of various machines used by the American Tobacco Co. Machines for making cigars and cigarettes will be demonstrated.

The first part of Dec. 9 afternoon's trip will cover the new Holland Tunnel. This remarkable vehicular tunnel, which is about two miles long, connects New York to New Jersey, and will be opened to the public in 1927.

After inspecting this tunnel by walking through it to New Jersey, the party will board buses and proceed to the Harrison Gas Plant of the Public Service Co. of New Jersey.

A tour, Friday, Dec. 10 at 10:00 a.m. will be made of the Hell Gate station of the United Electric Light & Power Co., located at 134th Street and East River.

Young Urges New England To Pool Her Power

Charging that the "progressive progress of New England has been handicapped by the lack of democratic organization," Owen D. Young, chairman of the board of the General Electric Co., urged Nov. 18 before the New England conference, the removal of physical and legal barriers and the turning of all New England water powers into a common pool, and that power needed for the New England market be drawn from a common reservoir.

This, he said, would enable the States to get the maximum benefit of the diversity of flow in New England rivers and the rainfall on its watersheds.

Owing to a cold, Mr. Young's prepared address was read by E. C. Buckland, vice-president of the New York, New Haven and Hartford Railroad, at the Broad Street High School, following the dinner.

Other speakers were Governor Trumbull of Connecticut and Governor Ralph O. Brewster of Maine, who flew here in an airplane from Boston.

"I am speaking of the removal of barriers in New England because wherever they exist they prevent the maximum development of New England," Mr. Young said. "In the case of the development and the transmission of power, there may be the physical barriers of disturbance, there may be the unseen barriers of laws or habits, but whatever they are they may be removed to insure a unified power supply and a unified distribution.

"In other fields of activity barriers exist, too. Some of them result from the fact you have six independent states or political divisions in one economic unit of activity. I would not be so silly as to advocate the breaking down of these political divisions for one political state of New England. Each of her historic states has its traditions, its political background, and its use to the inhabitants of this great district. I do advocate, however, such co-operation between these states as will break down the barriers to economic co-operation between these states—as will break down the barriers to economic co-operation in all fields and thereby insure the maximum use of the resources of New England for her own economic development.

Penn-Ohio Output Sets New Record

The October power output of 47,857,494 kw.-hr. reported by the Penn-Ohio power system, represents a gain of 19.2 per cent over October of last year and marks the third successive month in which a new record output has been established by these properties. For the twelve months to Oct. 31, the output totals 500,452,995 kw.-hr.

Protests Appalachian Power Project as Damaging

A recent hearing before Major H. M. Trippe at Radford, Va., in connection with the proposed hydro-electric development on New River by the Appalachian Power Co., brought out protests from several interests who fear that they will be damaged by this project.

Representatives of the Virginia Railway contended that the proposed dam would interfere with the water supply for their Narrows steam plant. Witnesses for the Norfolk & Western Co. fear that an ice hazard will be created for their bridge over New River. The Electro-Metallurgical Co. requested that any license issued to the Appalachian Co. safeguard the water supply for its power plant at Kanawha Falls. The Appalachian Co. is going ahead with its borings and other investigations.

Doherty & Co. Purchase Shore Power Properties

Henry L. Doherty & Co. purchased at public sale, Nov. 12, the physical properties of the Northwestern Light & Power Co., Toledo, Ohio. It was a receivers' sale.

The company has been in operation for years serving the entire bay and south Lake Shore district with light and power as far as Bono, Mominee-town and Graytown. The physical properties comprise about 30 miles of power transmission lines and other equipment. Current was purchased from the Toledo Edison Co.

The Edison Co. has lines into the general vicinity of Northwestern's territory, and the intention of the Doherty company is to ultimately turn the Northwestern property over to the Toledo Edison to operate.

Ottawa-Montreal Power Report Issued

The annual report of Ottawa-Montreal Power Co., Ltd., shows that the company has enjoyed a marked growth throughout the entire territory served.

Of outstandin,: importance is the steady increase in the number of customers and the consequent expansion of requirements to meet the demands of the various towns. The company, which operates in the district between Ottawa and Montreal, on the north shore, now has 3,874 customers, as against 2,525 last year, an increase of 1,369.

Buffalo, Niagara & Eastern Elects Directors

Directors of the Buffalo, Niagara & Eastern Power Corp. recently elected the following officers: Chairman of the board, Jacob E. Schoellkopf, succeeding the late Charles R. Huntley; chairman of executive committee, Fred D. Corey; first vice-president, William R. Huntley; vice-president and general manager, Alfred H. Schoellkopf. Other officers were continued.

White River Applications Up —Other Permits Issued

When the Federal Power Commission met Nov. 17 to consider the applications of the Ozarks Hydro-Electric Co. and the White River Power Co. for rights on the White River in Arkansas, a postponement was asked by each company. It is understood that negotiations looking to the settlement of the conflicting applications are in progress.

At the meeting the commission authorized a license for the Wisconsin Power & Light Co. covering a project on Wolf River in Shawano Co., Wis. The proposed dam will back up water to Keshena Falls and will effect a small portion of the Menominee Indian Reservation. A condition of the license will require the company to pay due regard to scenic beauty in the carrying out of its project works.

A preliminary permit was granted for the Fitkin Utilities, Inc., covering a project on the Santa Fe River in Florida. The primary power to be made available will be 1,650 hp.

A preliminary permit also was issued for the South Side Power Co. covering a project at Talley's Falls in the Roanoke River in Virginia. The dam is to be 40 ft. high and the pool 15 miles long. The primary capacity of the project is 3,600 hp.

Places Enlarged Generator In Operation

A 10,000 kw. steam-turbine driven twenty-five cycle generating unit at station No. 3 of the Rochester Gas & Electric Corp., went into operation Nov. 12 after being redesigned and rebuilt. The unit now has a capacity of 16,000 kw. at sixty cycles.

As requirements for twenty-five cycle current in this city grew smaller, it was decided to adapt the generator to the production of current of a higher frequency, which, with modern steam turbine improvements, has made it possible to produce a larger output.

Owing to lack of convenience at the plant the steam turbine was taken down and shipped to Schenectady for rebuilding.

Obituary

Bert Weedon, 44 years old, a director of the Interstate Public Service Company of Indianapolis and traffic manager for the company that operates interurban and light and power utilities in Indiana, died recently in an Indianapolis hospital. He had been in ill health for more than a year. Mr. Weedon was widely known in public utility circles of Indiana. Practically all his life was devoted to public-service corporation work. He joined the staff of the Interstate company as traffic manager in May, 1913.

Robert J. Rosenfeldt, senior vice-president of W. B. Foshay Co., of Minneapolis, Minn., died unexpectedly at his home in Minneapolis Nov. 18. Mr. Rosenfeldt, 68 years old, had complained of feeling ill during the past week, but refused to remain at home and was at his desk as usual on Thursday. He was born at Plymouth, Wis., April 18, 1858. He came to Minneapolis in 1914 and was engaged in the sale of securities for five years before joining the Foshay organization in 1919 as a member of its sales force. He rose to executive rank in the organization and was made vice-president four years ago.

Hazen Greeley Tyler, professor of experimental engineering in the College of Engineering, and director of the Evening Engineering Division, New York University, died Oct. 27, 1926, following an operation. His death brought to a close a life of activity in the teaching profession, to which he brought a point of view of close contact with engineering practice and an unusual amount of administrative ability. Doctor Tyler joined with Professor Bliss in the work of providing the Sage Laboratory with its equipment and in laying out the plans for the building. He was largely responsible for the work done by the Popular Science Institute of Standards. When the Evening Engineering Division of New York University was established in 1922, Doctor Tyler was chosen to organize and administer it.

In October 1917, Doctor Tyler went to New York University as assistant professor of mechanical engineering and in 1921 he was made associate professor. In 1924 he was made associate professor of experimental engineering, and in 1926 professor of experimental engineering. He was a member of the A.I.E.E. and the S.P.E.E.

Doctor Tyler's professional career has been closely linked with the A.S.M.E. From an enthusiastic member of the Student Branch at Brooklyn Polytechnic Institute, he became a junior member of the society in 1913, was promoted to associate member in 1918, and to member in 1925.

Personal Mention

A. H. Myers, formerly engineer with Stone & Webster, Inc., reports that he is now in the inspection department of the Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

W. Turnwald, formerly with the Stumpf Unaflow Engine Co. and now with the Chuse Engine Co., Mattoon, Ill., returned Nov. 15 on the S.S. "Hamburg" from a two months' visit in Czechoslovakia.

Harry W. Benton, until Nov. 13 employed by the Willys-Morrow Co. as maintenance engineer has resigned that position and is now taking up the duties of plant engineer with the Pratt & Whitney Co. at Hartford, Conn.

Burton L. Delack, assistant manager of the Erie, Pa., works of the General Electric Co., has been appointed assistant manager of the Schenectady, N. Y., works, effective Dec. 1, 1926. At the same time John St. Lawrence, general superintendent at Erie, has been named to succeed Mr. Delack there.

W. G. Diman is now associated with the Martell Mills, Inc., which company

controls many textile mills throughout the South. Mr. Diman's connection is that of consulting engineer. He will be stationed either at Charlotte or Spartanburg, S. C.

Arthur C. Flory was recently elected president of the Engineers Society of Milwaukee, having been active in the affairs of that organization for some years, serving on several committees previously to his vice-presidency a year ago. Since 1905 he has been associated with the Allis-Chalmers Manufacturing Co., where he held consecutively the positions of draftsman, engineer, assistant manager and manager of the steam turbine department. The last-named position Mr. Flory still holds. Mr. Flory is a member of the American Society of Mechanical Engineers.

Society Affairs

The Michigan Engineering Conference will hold its second annual meeting Thursday and Friday, Feb. 3 and 4, 1927, at the Hotel Statler, Detroit. There are expected more than 840 registrants in attendance from all parts of the State.

Business Notes

The Standard Turbine Corp., Scio, N. Y., announces the opening of a St. Louis office at 1905 Chemical Bldg. Mr. F. E. Bausch has been appointed manager.

The Bridgeport Brass Co., Bridgeport, Conn., recently appointed Mefford R. Runyon, district sales manager for the New York Metropol'tan district, Mr. Runyon comes to the Bridgeport Brass Co. with wide experience in the brass, copper and bronze field.

The American Brown Boveri Electric Corp. has announced that W. R. Foster, formerly of the Bridgeport Brass Co., Bridgeport, Conn., where he was employed as a sales engineer, has joined the corporation to engage in sales promotion at 165 Broadway, New York City.

The Botfield Refractories Co. recently appointed the following concerns as distributors for Adamant fire brick cement: The Curtis Supply Co. Inc., Buffalo, N. Y.; the Waldredh Supply Co., Des Moines, Iowa; South Side Foundry & Machine Works, Charleston, W. Va., and the Empire Machinery & Supply Corp., Norfolk, Virginia.

Trade Catalogs

Chicago Fuse Manufacturing Co.—Catalog No. 31 is a new general catalog published by the Chicago Fuse Manufacturing Co., Laflin and 15th Sts., Chicago, Ill. This catalog lists, describes in detail, and illustrates the full line of this company's products. The first section is devoted to Union renewable fuses and renewal links, Union indicating, non-renewable fuses, Gem non-indicating, cartridge fuses, Gem mica top plug fuses, Union fuse wire, cutout bases, cutout fittings, lugs, etc. The second section catalogs the full line of Union outlet boxes, bar hangers, extension rings and outlet box fittings. Gem switch boxes, including sectional, bracket and locktite types, are also covered fully in this section.

Coming Conventions

American Association for the Advancement of Science. Annual meeting at Philadelphia, Dec. 27-Jan. 1; Burton Livingston, Secretary, Smithsonian Institution Bldg., Washington, D. C.

American Engineering Council. Annual meeting at Washington, D. C., Jan. 13-15. L. W. Wallace, 24 Jackson Place, Washington, D. C.

American Institute of Electrical Engineers. Winter convention at New York City, Feb. 7-10; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers. Annual meeting at St. Louis, Mo., Jan. 25-28; A. V. Hutchinson, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers. Annual meeting to be held at Engineering Societies Bldg., 29 West 39th St., New York City, Dec. 6-9. Dr. Calvin W. Rice, secretary.

American Society Refrigerating Engineers. Annual meeting will be held at Hotel Astor, New York City, Dec. 6-8. Wm. H. Ross, secretary.

Chicago Power Show, at Chicago, Feb. 15-19. G. E. Pfisterer, managing director, 53 West Jackson Blvd., Chicago.

Engineering Institute of Canada. Richard John Durley, secretary, 176 Mansfield St., Montreal, Que. The forty-first annual general and general professional meeting will be held at Montreal on Thursday, Jan. 27, and will be adjourned to reconvene at Quebec City at the Chateau Frontenac Hotel Feb. 15, continuing on the two succeeding days.

National Association of Stationary Engineers. New England States convention at Portland, Me., June 17-18. Thomas H. Clark, president, Worcester, Mass.; Robert Johnson, secretary, 65 Charlotte St., Worcester, Mass.

National Electric Light Association. A. Jackson Marshall, secretary, 29 West 39th St., New York City. Annual convention at Atlantic City, week beginning June 6.

National Exposition of Power and Mechanical Engineering. Fifth Annual Exposition at Grand Central Palace, New York City, Dec. 6-11.

National Marine Engineers' Beneficial Association. Fifty-third annual convention at Washington, D. C., Feb. 14. Albert L. Jones, secretary-treasurer.

Transformer Flow Indicators and Insulated Union—Roy E. Hanson, manufacturing engineer, 5231 Navarro St., Los Angeles, Calif. The Hanson flow indicator is designed to give an indication of the flow of cooling water through transformers. Operating on the orifice principle, it registers continuously on a directly calibrated, large and easily read scale. Equipped with dirt traps and reservoirs which prevent any foreign matter from entering the indicating portion, this instrument can also be used for the measurement of cooling waters and lubricating oils to turbine bearings, condenser bearings and Kingsbury thrust bearings, and also successfully employed for the measurement of all liquids, steam or air. When used for the measurement of steam or air, the dirt traps serve as reservoirs.

Insulation - Testing Instruments — James G. Biddle, electrical instruments, 1211-13 Arch St., Philadelphia, Pa., has published Catalog 1145 on "Megger" insulation-testing instruments. "Megger" and "Bridge-Megger" testing sets, "Meg" and "Super-Meg" insulation testers and "Megger" and "Meg" ohmmeters, described in this catalog, comprise a complete line of "Megger" instruments for the rapid and convenient testing of electrical insulation and measurement of resistance.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	Nov. 15 1926
Pool 1	New York	$4.00@$4.25
Smokeless	Boston	5.79
Clearfield	Boston	2.75@ 3.50
Somerset	Boston	3.00@ 3.50
Kanawha	Columbus	3.50@ 4.25
Hocking	Columbus	2.50@ 3.00
Pittsburgh	Pittsburgh	2.50@ 3.00
Pittsburgh gas slack	Pittsburgh	2.00@ 2.40
Franklin, Ill.	Chicago	2.75@ 3.00
Central, Ill.	Chicago	2.50@ 2.75
Ind. 4th Vein	Chicago	2.50@ 2.75
West Ky.	Louisville	1.75@ 2.25
S. E. Ky.	Louisville	3.75@ 4.50
Big Seam	Birmingham	2.00@ 2.25
Anthracite Gross Tons		
Buckwheat No. 1.	New York	2.35@ 3.50
Buckwheat No. 1.	Philadelphia	2.40@ 3.00
Birdseye	New York	1.35@ 2.00

FUEL OIL

New York—Nov. 24, light oil, tank-car lots; 28@34 deg. Baumé, 5¾c. per gal.; 36@40 deg., 6¼c. per gal. f.o.b. Bayonne, N. J.

St. Louis—Nov. 16, tank-car lots, f.o.b. St. Louis; 24@26 deg., $2.05 per bbl.; 26@28 deg., $2.10 per bbl.; 28@30 deg., $2.15 per bbl.; 30@32 deg., $2.20 per bbl.; 32@36 deg., gas oil, 6.1c. per gal.; 38@40 deg., 7.7c. per gal.

Pittsburgh—Nov. 16, f.o.b. local refinery; 30@34 deg., fuel oil, 6¼c. per gal.; 36@40 deg., fuel oil, 6¾c. per gal.

Philadelphia—Nov. 18, 27@30 deg., $2.52@$2.58 per bbl.; 13@19 deg., $1.725@$1.785 per bbl.

Cincinnati — Nov. 15, tank-car lots f.o.b. local refinery, 24@26 deg. Baumé, 6¼c. per gal.; 26@30 deg., 6⅝c. per gal.; 30@32 deg., 7c. per gal.

Chicago—Nov. 6, tank-car lots f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.35 per bbl.; 26@30 deg., $1.45; 30@32 deg., $1.65.

Boston—Nov. 22, tank-car lots f.o.b. 12@14 deg. Baumé, 4.85c. per gal.; 28@32 deg., 6c. per gal.

Dallas—Nov. 9, f.o.b. local refinery, 26@30 deg., $1.70 per bbl.

New Plant Construction

Calif., Los Angeles—County Supervisors, will receive bids until Dec. 6 for combination oil and gas firing equipment for five boilers in power house at county hospital.

Calif., Madera—City, J. Wakefield, Clk., will receive bids until Dec. 6, for a deep well turbine pump.

Conn., New Britain—J. D. Williamson, City Engr., has submitted several plans to A. Hazen, 25 West 43rd St., New York, N. Y., Engr. for the construction of a pumping station, reserve reservoir, also raising dam at Shuttle Meadow Reservoir. Estimated cost approximately $1,000,000. W. J. Hatch is chairman of water commission.

Ill., Chicago—One Hundred Eighty West Washington St. Building Corp., A. F. Klink, Pres., c/o Ready, McCormack & Straus, 110 South Dearborn St., awarded general contract for the construction of a 12 story office and stores building to Duval-Herrling & Co., 190 North State St. Estimated cost $1,000,000.

Ill., Chicago—Syndicate, c/o Levy & Klein, 111 West Washington St., Archts., is having plans prepared for the construction of a 12 story apartment including electric refrigeration, swimming pool, etc. at Kenmore and Bryn Mawr Aves. Estimated cost $2,000,000.

Ill., Chicago—Carl Wishnack, 112 South Wells St., will soon receive bids for the construction of an 18 story apartment at 5861 Sheridan Rd. Estimated cost $1,500,000. McNally, Quinn & Co., 8 South La Salle St., are architects.

Me., Portland—Dartmouth Real Estate Trust Co., c/o B. Rumery, Pres., awarded contract for the construction of a garage and power plant on Baxter Blvd., to F. A. Rumery Co., 537 Congress St. Estimated cost $850,000.

Md., Baltimore — Mallory Machinery Corp., 522 Light St., is in the market for a 100 to 125 hp. Deisel engine.

Md., Hagerstown—City is having plans prepared for the construction of a 10,000,000 g.p.d. pumping and filtration plant. G. L. Bean, 261 North Broad St., Philadelphia, Pa., is consulting engineer.

Mass., Boston—Dept. of Public Works, City Hall, will receive bids until Dec. 6 for motors and control for Warren Bridge Draw.

Mass., Boston—D. Saklad, 108 Pemberton Bldg., will build a 5 story apartment including electric refrigeration system, elevators, etc. Estimated cost $900,000. S. E. Motlie, 51 Cornhill, is architect. Work will be done by separate contracts.

Mass., Malden (Boston P. O.)—H. P. Hood & Son, Inc., Charlestown, had plans prepared for the construction of an office, storage and refrigeration plant, at 339 Washington St., here. G. C. Mourse, c/o owner, is engineer.

Mass., Quincy (Boston P. O.)—Norfolk Woodworking Co., 53 Wyman Rd., Braintree, is having plans prepared for the construction of a group of buildings including boiler house, ice building, etc. here. Estimated cost $200,000. L. S. Joslin, 339 Newbury St., Boston, is architect.

Mass., Somerville (Boston P. O.)—New Creamery Products Co., Somerville Ave., awarded contract for the construction of a refrigeration plant at Somerville Ave. and Fitchburg St., to New England Foundation Co., 120 Tremont St., Boston. Estimated cost $40,000.

Mass., South Boston (Boston P. O.)—Andrew Sq. Terminal Co. Inc., F. A. Kamp, 53 State St., Boston, is having plans prepared for the construction of a group of industrial buildings including central heating plant and power house, 4 electric elevators, coal handling equipment, etc. on Dorchester Ave., here. R. M. Stowell, 184 Boylston St., Boston, is architect. H. S. Clervedon, 184 Boylston St., Boston, is engineer.

Mich., Detroit — A. Kahn, 1000 Marquette Bldg., Archt., is receiving bids for the construction of a machine shop on Lynch Rd. for Dodge Bros., Inc., Jos Campau Ave. Motors to operate machine equipment will be required.

Mich., Flint—Hurley Hospital, will receive bids Dec. 1 for the construction of a 10 story hospital addition including small central refrigeration plant, 4 elevators, etc. at 6th and Begole Aves. Estimated cost $1,600,000. Thielbar & Fugard, 219 East Superior St., are architects.

Mich., Plymouth—Detroit House of Correction, Alfred St., Detroit, will soon award contract for the construction of a boiler house here. Two 173 hp. boilers including feed pumps, etc. will be required.

Miss., Jackson — Mississippi Building Comn., R. L. Brown, Secy., will receive bids in January for the construction of a group of hospital buildings including central heating plant on State St. Estimated cost $2,500,000. N. W. Overstreet, Mississippi Fire Insurance Bldg., is architect.

Mo., Kansas City—City Ice Co., 21st and Campbell Sts., awarded contract for the construction of addition to ice plant at 85th and Olive Sts., also new ice plants, 80 to 100 ton capacity at 75th St. and 60 to 80 ton capacity at 15th and Cottage Sts., to Patti Construction Co., 626 Lee Bldg. Estimated cost $85,000, $75,000 and $75,000 respectively.

Mo., Marceline — City, L. E. Shelton, Clk., will receive bids until Dec. 6, for one engine direct connected to a 375 kva. generator, 3 ph., 60 cycle, 2300 v., 150 r.p.m.

Mo., St. Louis—Local Syndicate, c/o H. R. Weisels Inc., 8th and Chestnut Sts., is having preliminary plans prepared for the construction of an 8 story hotel at Delmar St. and De Baliviere Ave. Estimated cost $1,000,000. Private plans.

Mo., St. Louis—William Fox Film Co., 55th St. and 10th Ave., New York, N. Y., is receiving bids for the construction of a 17 story theatre and office building at Grand and Washington Blvds. here. Estimated cost $5,000,000. C. H. Crane, E. G. Kiehler and B. A. Dore, 400 Huron Bldg., Detroit, Mich., are architects.

Mont., Great Falls—H. M. Sprague, 1600 4th Ave. N., is in the market for 1 to 4 in. rotary water motors to operate under heads 50 to 200 ft.

Neb., McCook—City G. F. Moss, Clk, will receive bids until Dec. 6 for waterworks improvements including wells, pumps, tank on tower, etc. Estimated cost $45,000. Bruce & Grupe, 710 Bankers Reserve Bldg., Omaha, are engineers.

Neb., Omaha—Filter Service Co., 407 Karboch Bldg., will build an ice plant at 24th and Parker Sts. by day labor. Estimated cost $75,000. Private plans.

N. Y., Adams—Bd. of Trustees, will receive bids until Dec. 15, for extensions and improvements to waterworks including pump house, etc.

N. Y., New York—Dept. of Public Welfare, Municipal Bldg., will soon award contract for the construction of an emergency pumping station and power house at Sea View Hospital.

N. Y., Scarsdale—Bd. of Water Comrs., Greenville Water Dist., F. A. Rice, Secy., Greenville Fire House, Central Park Ave., Scarsdale, will receive bids until Dec. 10, for furnishing a Diesel engine, centrifugal pumps, air tanks, etc. with all necessary equipment. J. N. Heeney is engineer

N. C., Lenoir—A. A. Shuford, Hickory and F. N. Laxton, Charlotte, plan the construction of a hydro-electric power development including dam 250 ft. high, power house, etc. on Wilson Creek near here.

O., Cleveland — City will receive bids until Dec. 3, for screen equipment, water racks and vacuum heating pumps for Kirtland Pumping Station.

O., Cleveland—The Shelton Realty Co., c/o Braverman & Harvermaet, Ulmer Bldg., Archts., awarded contract for the construction of a 9 story hotel at East 102nd St. and Euclid Ave. to Crowell & Little Construction Co., Hanna Bldg. Estimated cost $1,000,000. Steam heating system, elevators, etc. will be installed.

Okla., Welcetka—Oklahoma Power Co., Okmulgee, awarded contract for the construction of a 50,000 kw. steam power plant here, to Myers Construction Co., Chicago, Ill. Estimated cost $2,000,000. Machinery and equipment to be purchased.

Ore., Portland—M. W. Howard, Kreamer Bldg., will receive bids after Jan. 1 for the construction of a 15 story hotel at 9th, 10th, Madison and Jefferson Sts. Estimated cost $2,500,000. L. L. Dougan, Kreamer Bldg., is architect.

Ore., Portland—Portland Gas & Coke Co., G. W. Talbot, Pres., awarded contract for the construction of a 15 story office building at Salmon, Taylor and 6th Sts. to L. H. Hoffman, U. S. Mail Bank Bldg. Estimated cost $1,500,000.

Pa. New Castle—National Radiator Co., P. S. Waters, Secy., Johnstown, awarded contract for the construction of a group of buildings including boiler house, etc. here, to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O. Estimated cost $450,000.

Tenn., Lewisburg—The Borden Southern Co. subsidiary of the Borden Co., 350 Madison Ave., New York, N. Y., awarded contract for the construction of a plant including boiler house, engine room, etc. here, to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O. W. H. Howard is superintendent of construction and equipment section, manufacturing department.

Tex., Amarillo—Badger Ice Co., Oklahoma City, Okla., has acquired a site and plans the construction of a 150 ton ice and refrigeration plant here. Estimated cost $250,000. Electrically driven machinery will be required.

Tex., Amarillo—Neptune Oil Corp., Nunn Bldg., is having plans prepared for the construction of a casinghead gasoline plant including boilers, storage tanks, etc. Estimated cost $28,000. F. L. Brimi is engineer.

Tex., Fredericksburg — A. C. Kellersberger & Associates, c/o County Comrs., has been granted franchise to construct a complete waterworks and distribution system including wells, pumps, etc. Estimated cost $40,000. Engineer not selected.

Tex., San Angelo—San Angelo Water, Light & Power Co., is having plans prepared for the construction of a power plant on Lake Concho to generate power for use in city and other towns in vicinity, also electric transmission lines. Estimated cost $837,000. Private plans.

Tex., San Antonio—Woods Properties Corp., H. C. Wood, 907 Travis Bldg., plans the construction of a 16 story hotel including steam heating and ice water circulating systems, etc. at Navaroo and Martin Sts. Estimated cost $600,000. Kelwood Co., 907 Travis Bldg., is architect and engineer.

Wash., Black Diamond—Pacific Coast Coal Co., L. C. Smith Bldg., Seattle plans the construction of an office building warehouse, power plant, shops, etc. here. William Aitken, Lyon Bldg., Seattle, is architect.

Wash., Okanogan — Okanogan District voted to approve plans for the construction of a pumping plant. Estimated cost $300,000.

Wash., Olympia—Thurston County voted $250,000 bonds for port improvements including cold storage building, freight handling equipment, etc. E. L. Van Epps, is engineer.

Wis., Embarrass—Wisconsin Power & Light Co., 16 North Carroll St., Madison, plans the construction of a dam and 60 x 150 ft. power plant here. Engineer not selected.

Wis., Milwaukee—State Bd. of Normal Regents, W. Kittle, Secy., Madison, plans the construction of a gymnasium and central heating plant here. Total estimated cost $215,000. A. Peabody, Capitol, Madison, is architect.

Wis., Stoughton City plans the construction of an electric light plant. Estimated cost $40,000. Engineer not selected.

Ont., Toronto—Bd. of Education, W. W. Pearse, Secy., 155 College St., will soon receive bids for the construction of a 3 story technical school and high school of commerce including steam heating and ventilation systems, ash handling equipment, elevators, etc. on Glendonwynne Ave. Estimated cost $1,152,000. C. Dyson, 155 College St., is architect.

N. Z., Wellington—New Zealand Government Railways, will receive bids until Dec. 15, for switch gear, junction boxes, trifucating boxes, motor-generator sets, etc. for Hutt Valley locomotive workshops.